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THE FINANCIAL RECOVERY.

Slowly but surely the financial situation is righting, and one of the best signs of this is the dwindling premium on currency. If there be hoarding, there can be no trade but the primitive and barbaric kind called barter; and reduced to that civilization itself disappears. Money that was hidden away under the impulse of panic is again emerging freely from holes in the ground, and the use of it to settle debts and make purchases of goods or securities is vitally helpful.

The worst hoarders of all at the present juncture are the banks themselves, many of which are as criminal in their denial of proper credit as others are in the looseness of their management. If, instead of denying credits to manufacture and industry and piling up huge, abnormal reserves that are no earthly good to anybody, the banks would see to it that no good commercial paper was refused discount and that the hands and wheels of industry could thus be kept going, the banks would be discharging the function for which they were created. As Mr. J. J. Hill said truly this week: "Credit is the atmosphere which inflates the lungs of business, and when it is greatly lessened, business must be reduced in proportion or be quietly smothered." It is now for the banks to forget there was a panic and to live up to their opportunity.

Business, for example, has been and is good in the electrical field, but denied the ordinary, legitimate facilities it would fade away; while on the other hand, the regular demands for electrical apparatus and energy cannot be satisfied through a long series of years to come. Last year the consumption of that character was $12 per capita in this country. During the past month we have published nearly 300 separate items of new construction, and have noted that since the middle of October operations have been proposed by 57 new electric companies with a capital of $28,000,000. This does not include all the previous work laid out since January. Discreetly financed, that development can but add to the wealth, resources and comfort of the whole population, but it must have for that very purpose some of the millions salted away with pessimistic cowardice a few weeks ago, and now being held in worse than idleness. There are times when courage is a much higher virtue than conservatism, and this is one of them.

ABNORMAL CONDITIONS IN TRANSFORMER OPERATION.

An article in this issue by Mr. J. Murray Weed again directs attention to the investigation of the abnormal primary current and secondary voltage on placing a transformer in circuit, as reported by Mr. Tyrvge Jensen in our issue for Sept. 14. The author of the present article agrees with the investigators in attributing the abnormal phenomena observed to the increase in the reluctance of the transformer core with the higher magnetic densities. It seems well to mention in this connection an additional cause which contributed somewhat to the results, namely the electrostatic capacity of the transformer windings. If the capacity effect were the predominating one, then an enormous rush of charge would take place upon closing the

primary circuit at the instant when the supply e. m. f. has its maximum value. The fact that no such rush was observed proves either that the capacity effect was insignificant or that the oscillograph was not sufficiently sensitive to record the rush on account of the brevity of its existence. It is probable both that the capacity was small and that the instruments were unable to detect the current representing the rush of charge. In view of the results actually recorded by the instruments used, the explanation offered by Mr. Weed covers in a clear manner the phenomena known to exist.

Two-Candle Power Sign Lamps.

Some central-station companies have discouraged the use of 2-cp lamps for electric signs, because they have feared that the use of such small lamps would reduce the revenue from sign lighting. It has also been urged that the 2-cp lamp is very inefficient, taking about 12 watts, as compared with 19 or 20 watts, for the 4-cp lamp. While it is true that the efficiency of the 2-cp lamp is much lower than that of the 4-cp lamp, yet for the same amount of power the larger number of lamps that can be operated in a sign should more than compensate for this. While it would cut down the revenue from existing sign users to substitute 2-cp for 4-cp lamps, the general use of 2-cp lamps means in the long run larger revenue because of a much more general use of electric signs. If, for example, a small merchant can obtain an electric sign with 2-cp lamps, at a cost of two-thirds what he would pay for 4-cp, many more small merchants will invest in signs. We have in mind one city where the electric sign business has had a wonderful growth without any special effort on the part of the central-station company, except to give free renewals of 2-cp lamps. The signs in this city are numerous, and in many cases more legible than the same signs would be with 4-cp lamps. The larger the lamps, unless the sign is a great distance away, the greater is the blurring effect. In a sign where 2-cp is ample, the greater efficiency obtained by 4-cp lamps is worse than useless. The low operating cost of 2-cp lamp signs is undoubtedly a great stimulus to the sign business in the city referred to, and the example might well be followed elsewhere.

The Leakage Coefficient of Induction Motors.

Of all of the calculations relating to dynamo-electric machines that dealing with the "stray" flux in the air gap is the one most subject to error, by reason of the fact that no method has ever been devised for the exact determination of such flux. The importance of obtaining a method of calculation that gives results in reasonable agreement with actual conditions will be appreciated when one considers that the performance of alternating-current machinery varies largely with the value of the local magnetic reactance of the windings. In fact, it may truly be stated that no calculation connected with the predetermination of the performance of an induction motor is of greater importance than that of the magnetic leakage. It is not correct to infer from the statement just made that it is essential for the value of the leakage to be known with absolute accuracy. Indeed, a formula based on absolutely accurate theory for representing the leakage, in addition to being impracticable for use on account of its complication, would lead to absurd fineness, because experience shows that induction motors built according to the same patterns and by the same tools in the hands of the same workmen differ as much as 15 per cent in their "leakage coefficients." Thus, a simple practical working formula which gives results differing by less than 15 per cent from actual test results on motors of various types is entirely satisfactory for all purposes for which the formula can be used. A formula that seems to possess the requisite degree of accuracy is given by Mr. R. E. Hellmund on page 1004 of this issue. In its final shape, especially when expressed in "safe" terms, the formula is extremely simple and convenient, all of the factors being reduced to machine dimensions.

Rubber Insulation for Electrical Conductors.

There used to be a standing subject of disputation among electrical engineers over which an animated discussion could ordinarily be invoked upon the smallest opportunity—namely, the utility of storage batteries to central stations. That subject has lost most of its charm from the standpoint of a controversialist, because so much more is now known about storage batteries, both from practical experience and from laboratory study. A fairly good substitute for controversy in recent times has appeared in the matter of specifications for hard-rubber cables. There are some persons who are to be envied for the enthusiasm they can develop on this topic at short notice. Engineers have been using rubber-covered wires of one kind or another for more than half a century, yet the physics and the chemistry and the practical applications of rubber-covered wires are so complex that we are still compelled to employ empirical rules in many important details. What are required are more information, analysis, generalization and experience in the direction of high-tension cables.

The article on this subject by Mr. Fred J. Hall, of which the first section appears on page 1009 in this issue, contains a number of useful facts and practical deductions. It is pointed out that the acetone test is often misinterpreted, and that the extractive matter in rubber is more likely to interfere with the success of the vulcanization process than with the durability of the material. It is recommended that 7 or 8 per cent of extractive matter in gum, as obtained by acetone test, including free sulphur, should be regarded as permissible. It is claimed in regard to the stretching test for mechanical elasticity, that specifying a stretch test for high-tension rubber insulation invariably means reducing the electrical factor of safety. If this statement can be substantiated by relative observations, it should certainly be widely distributed. It is in contravention to views that have been published by persons trained in the rubber-cable industry. The paper recommends, however, that in small sizes of wire a stretch test, with the very moderate extension ratio of three, should be adopted.

In regard to the high-voltage test, it is recommended that either twice the maximum working voltage should be applied to the cable for 30 minutes or that 2½ times the maximum working voltage should be applied for 5 minutes. If these two aplications are intended to be considered in the light of experience as equally severe, the figures would indicate that between these limits the time of applying the voltage should be inversely as the eighth power of the voltage. A half-hour test is, we believe, altogether too long for practical use. Even a five-minute test is a long test in factory practice, where many samples have to be tried. A two-minute test would be greatly preferable, or even a one-minute test. We think the author is entirely justified in taking the position that excessive voltage should not be applied to a cable during tests. One might as well endeavor to determine the breaking stress of the Brooklyn

Bridge by loading it until it broke. All we can hope to accomplish in the way of tests after manufacture is to make sure that there is no incipient fault in the insulation, by applying a moderately high voltage for a suitably short period, well within the electric elastic limit. This testing voltage should not ordinarily be less than twice the working voltage that the cable must withstand. At the same time, break-down tests on short separate samples of the cable are very valuable, and not one only, but a number of such short samples must be tested, if the purchaser is to know what factor of safety his cable possesses. The civil engineer breaks down test-pieces of the material from which a bridge is built, and from a number of such tests he arrives at a warrantable estimate of the factor of safety of the completed structure. The electrical engineer should follow this example, and determine the braking-down voltage of short samples of his cable under different conditions of age, temperature and duration of test-voltage.

A good word is given as to the meaninglessness of the "30-per cent rule" for pure para rubber in cable coverings. This 30-per cent rule may be reliable under certain empirical conditions, but it has been made a fetish. It resembles the old rule that a pump would not raise water above 30 ft. because, as Galileo humorously remarked when he investigated the phenomena, Nature ceased to abhor a vacuum beyond 30 ft. It is reasonable to expect that as we get to know more about rubber insulation, engineering specifications will cease to abhor a dielectric containing less than 30 per cent pure para gum. If reclaimed rubber can be utilized in cables all the better; and the manufacturer should be encouraged in his attempts, provided that he does not conceal or misrepresent the facts. No purchaser can be blamed, on the other hand, for suspecting the durability of a cable insulated with material containing an unduly large proportion of reclaimed rubber.

TRANSMISSION IN THE ANTIPODES.

We are fortunate in being able to present this week a very full account of the first high-tension power transmission plant in New Zealand—indeed the first in Australia. New Zealand in many respects an ancient land of wonders, is in no wise more remarkable than in the amount of hydraulic power available for development. With about the same area as the State of Colorado, the horse-power suitable for hydro-electric utilization rises to 3,700,000, or nearly 37 horse-power per square mile. This is a tremendous allotment which should bespeak an immense industrial growth in due season in conjunction with the development of near-by Australia. One cannot help, in considering water-power, an instinctive casting forward to days in which the lessening fuel supply shall have shifted the world's centers of activity. If recent forecasts be true, those days are drawing near enough to be seen by the grandchildren or great-grandchildren of men even now living. The Waipori plant, which we here describe, is only the beginning then of the utilization of New Zealand's resources. It is a typical example of high-head working, carried out along the lines already familiar on our Pacific Coast, and in very thorough and workmanlike fashion. The water of the Waipori River, taken out by means of a short ballasted crib dam, is led for nearly two miles through a system of timber flumes and tunnels, and is then plunged through a pipe line down to the power house.

In the construction of the flume attention should be called to the preparation of material on the spot by means of a temporary hydraulic installation. An impulse wheel worked under 120 ft. head was installed at a convenient spot, operating a saw mill, and then a cable tramway about five-eights of a mile long carried the timber to the scene of action. In addition, a four-mile wooden tramway system was laid for bringing the logs to the mill, in which some 1,400,000 ft. of lumber were prepared for use. This sort of preliminary engineering is coming to be an important economic feature of not a few large enterprises, and should be regularly taken into account as one of the factors in cheap construction. The Waipori pipe line is somewhat out of the ordinary in that it is constructed of open-hearth steel. The latest practice is followed in the omission of any receiver back of the wheels, but an unusual feature is introduced in the form of an air chamber kept filled automatically by a motor-driven compressor at the pipe-line pressure and serving as a cushion to protect against "water-hammer." Its space is about 210 cu. ft., and the working pressure is 288 lbs. per sq. in. The branches at the lower end of the pipe line are of gray cast iron. The water is received on a pair of Pelton wheels for each generator, regulated by Lombard governors. The form of regulation presents some peculiarities, the nozzles being provided with needle valves, but the regulation proper being by deflecting the nozzles. The considerable amount of suspended matter carried by the stream has doubtless influenced this construction. It is worth noting that the efficiency of the wheels at full load proved under test to be 83 per cent, while there is a 50-per cent overload range for which also the duplex regulation serves an important purpose.

Electrically the plant is upon familiar lines. There are at present two 1000-kw, 50-cycle generators working at 2400 volts. These feed a bank of transformers arranged in two groups of three with a seventh as a spare unit. The connection is mesh on the low-tension side and star on the high-tension side, bringing the working e. m. f. to 34,700 volts. The station has hydraulic power back of it sufficient for three times the present equipment when extensions become necessary. From the station, proceed two 35,000-volt lines. The station wiring is mostly of bare copper and the switching apparatus is, as in many recent stations, elaborate to the point of excess. It occupies nearly as much space as all the rest of the station, and must have been correspondingly costly. The station, however, is simple in operation and seems to have given most excellent results. It is handled by a staff of but seven men. One curious fact noted is the extreme noisiness of the plant, which compels the use of megaphones in the operating room if conversation is desired. High-head impulse wheel plants are never exactly soothing in their quietude, but it would seem that in this case some extra care devoted to silencing the racket would have been well worth the while. Altogether, the Waipori plant is a very good example of its class, and should prove a substantial and profitable enterprise, and the forerunner of many others. It would be exceedingly interesting to know the cost of construction of this plant in detail, and the economies that were effected by the adroit use of local resources in material and labor-saving opportunities. Engineers, even the best of them, tend to get into ruts, and nothing helps them out more effectively than the study of what other engineers, working perforce under very different conditions, have been able to accomplish in the way of economical special construction.

Meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers.

The eighth annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held in the assembly room of the Hollenden Hotel, Cleveland, Ohio., on Friday and Saturday of last week. President W. T. Magruder occupied the chair and took part in the deliberations. A portion of the forenoon on Friday was taken up with business meetings and a meeting of the council. The secretary's report showed the organization to be in a healthy condition financially. The membership is now 249.

The first paper was prepared by Mr. W. L. Morris on the subject, "Some Suggestions Concerning the Management of Engineering Societies," but as he was prevented from being present, it was read by Secretary F. W. Ballard, of Cleveland. Mr. Morris contended that an organization of this kind should be conducted differently from a school and that all school studies should be eliminated. All papers should furnish the society with something that can not be gotten from books. They should contain experiences, with figures representing the actual tests and results. If formulae are used, then the books from which they are taken should be named and filed with the society for examination. They should not advise, but tell what was done.

Every society should have instruments with which its members may conduct experiments and endeavor to arrive at valuable results for the good of themselves and the entire body. These instruments could be used by members in conducting the work of their employers, and in such other ways as might be suggested in return for a reasonable charge. A committee should have charge of the instruments and experiments.

The discussion brought out the fact that all the members are ready for as much new information as they can get, and a number of them commended the paper on this point. They thought new experiences especially should be made the subject of papers, in order that discussion might bring out information to the fullest extent. However, President W. T. Magruder objected to the statement that nothing included in the school books and other books should be taken up in the papers. He said that it is practically impossible for any man to write a paper that is original in every way and contains all new matter. In fact, it would be difficult to write a paper that contains any ideas that are entirely new. Even in his own paper, Prof. Magruder said the writer had done just what he advises against.

Some of the members objected to the plan of purchasing instruments for the use of the society. They said that instruments used indiscriminately would soon go to pieces and to purchase and keep them in repair would become a heavy burden. The paper was considered idealistic and the plan a good one if it could be carried out, but men have not reached that stage where they can fall in love with that which is really ideal in engineering or anything else.

MANUFACTURE OF INCANDESCENT LAMPS.

The second paper was read by George Loring, of Cleveland, the subject being "Manufacture of Incandescent Lamps."

In his paper, Mr. Loring considered the manufacturing details relating to the filament, the stem and its mounting, the bulb, sealing the mount into the bulb, exhausting the lamp and attaching the base. He then discussed the manufacturing differences between plain and graphitized carbon filaments, tantalum and tungsten lamps.

The chief difference in the manufacturing make-up of a graphitized carbon filament lamp compared to a plain carbon is that the thread of the former is baked in an electric furnace before and after being treated. The tantalum lamp varies from a carbon in the process of manufacture chiefly in the methods used in mounting. The tantalum filament, on account of its extreme length, is wound upon trees connected to the ordinary stem of the lamp where the anchor is generally found. The platinum does not protrude from the end of the stem, but is joined to a small copper wire with a tubed end. This extends from the stem for an inch or so, and into it is inserted the end of the tantalum filament, a connection and contact being made by crushing the copper together. No paste is used. The filament of a tantalum lamp is entirely different from the cellulose or carbon, inasmuch as it is a wire drawn from the metal from which it is named.

The method of mounting a tungsten filament differs from that employed with a carbon. The platinum at the end of the leading-in wires is entirely embedded within the sealed portion of the stem. The ends, which generally protrude, are connected with copper wires which extend through the stem into the lamp and are welded to the filament. The filament is also produced in an entirely different way, the result being a thread made out of practically pure tungsten.

The lowest commercial specific power consumption of an ordinary 50-watt carbon filament lamp is 3.1 watts with a life of approximately 500 hours; of a 50-watt graphitized filament lamp 2.5 watts, with an equal life; of a 40-watt tantalum lamp 2 watts, with a life of 800 hours on direct current, 600 hours, 25-cycle, and 400 hours 60 cycle; of a tungsten 40-watt lamp 1.25 watts with a life of 1000 hours. Only the useful life is considered in giving the above figures, and the specific consumption is based upon the mean horizontal measurements of the illumination.

The highest practical e. m. f. that can be used with the tantalum lamp, Mr. Loring said, is 130 volts. With regard to copper leading-in wires, the speaker said that he had had no experience, but that he had no doubt that Edison had tried this out thoroughly in his experiments, and that if copper could be used successfully it would have been taken up some time ago. The 3.8-watt lamp is best adapted to commercial use at an e. m. f. of 250 volts.

In answer to a question regarding the use of alternating current with the tantalum lamp, the speaker said that the lamp was intended originally for direct current. Alternating current causes the filament to become rough and it gives way sooner than when used with direct current.

Regarding the graphitized carbon-filament lamps, the speaker said that the first cost is greater, but that the cost of energy would be about the same as of the plain carbon lamp. It makes up in greater brilliancy and life for the additional original cost. It is cheaper to use a Gem 2.5-watt lamp than a 3.5-watt carbon lamp. Of all the lamps in use Mr. Loring said he favors the tantalum lamp, as it has proved a good one and the demand for it is now showing its popularity. The tungsten lamp will probably come in later on.

The afternoon was spent in an inspection of the factory of the Sherwin-Williams Company, where every department of interest to engineers was given attention.

The first exercise at the evening session was an address by President W. T. Magruder on "Some Suggestions on Industrial Education in Ohio."

INDUSTRIAL EDUCATION IN OHIO.

Prof. Magruder stated that the higher technical education, as given at the State University at Columbus, at the Municipal University at Cincinnati, and by the Case School of Applied Science in Cleveland, continues to be in increasing demand; that manual training has been introduced into the grade schools of Columbus and a number of other cities, that it is flourishing in Cleveland and in the new high school manual training annex at Akron, and that a new manual training high school is being built at Dayton; that the various branches of the Y. M. C. A. throughout the state are busier than ever in their industrial departments, offering to men and boys the technical education that they have not been able to obtain previously; and finally, that one or more manufacturing establishments have entered the field of education and are operating shop-schools for their apprentices. The one distressing part of the whole outlook is that very little is being done for the industrial education of the masses. Prof. Magruder stated his

belief that the establishing of trade schools is greatly to be desired for the benefit of a large number of younger citizens. He asked the society to instruct the council to memorialize the next session of the General Assembly, asking for the appointment of a commission on industrial education and industrial conditions to collect facts and disseminate information on the subject of industrial schools, to advise municipalities, manufacturing corporations and public-spirited citizens on the subject, and to report at as early a date as possible on the advisability of establishing one or more industrial schools in each manufacturing district of Ohio.

H. M. Lane, at the close of the address, made a motion that a committee be appointed to memorialize the general assembly, asking that a commission be appointed to take up the question of establishing industrial schools in the principal manufacturing cities and districts of the state. Messrs. Magruder, Miller and Ballard were named as members of the committee.

Most of the members agreed so thoroughly with all that Prof. Magruder said that there was not much room for the discussion of the address. A general need for industrial schools is recognized in the state, and a number of engineering organizations have taken the matter up. Without doubt the movement will result in something of advantage to the industry.

A paper read by W. A. Rowe on "Air Washing and Humidifying and Some of Its Industrial Applications" was interesting to those who have to do with large building operations where ventilation and pure air are desired. As the subject was somewhat removed from the work of most of the engineers, however, but little discussion followed. The idea of dehumidifying air for use in blast furnaces attracted attention, however, and the members will look forward to the results of the experiments that are now under way in that direction. Mr. Rowe made use of illustrations in the printed copy of his paper to make the various points clear.

B. F. Houghton, of the Cleveland Electric Illuminating Company, in his paper on "Power, Heat and Light from Central Stations," opened up a topic of interest to all who are engaged in the lighting business.

CENTRAL STATION VS. ISOLATED PLANT SERVICE.

The paper by Mr. Houghton gave the following outline of the disadvantages of isolated plants: Vibration of building from power plant, which has a weakening effect upon the structure; very often fires are started in the coal storage by spontaneous combustion, thus endangering the building; handling coal and ashes around the building; excessive heat in summer in stores or offices over engine rooms; higher insurance rates; probability of higher prices for supplies; losses due to the destruction of property and materials by dust and moisture from plant; risk of damages to employees and public through accidents, such as explosion of flywheel or boiler.

The advantages derived from purchasing electrical energy from a central station were given as: Continuous service for 24 hours per day, 365 days per year; all night lighting service; all night elevator service; dispenses with a large percentage of the dirt of building; eliminates trouble with smoke inspector and neighboring buildings.

The discussion was opened by a reply written by A. M. Allen and, in his absence, read by Secretary Ballard. Mr. Allen took exceptions to a statement that central stations are taking the place of isolated plants, and said that the details of many manufacturing establishments make it both cheaper and more convenient to operate their own electrical plants. The chief trouble with isolated plants is that manufacturing concerns do not give them the attention they deserve and allow them to operate as they will as long as they drive the machinery. The cost of operation is included in the expense account of the establishment, and no trouble is taken to ascertain whether they are really paying propositions or not. All this will be remedied when the manufacturer learns to keep a record of the cost of his energy and compares it with the cost of energy from the central station. Mr. Allen says that the rejected heat from the exhaust steam may be used throughout a part of the year for heating the building, and that other economies may be practiced that are usually not availed of at the present time.

Mr. Allen took as an example two small generating plants, one of them operated by steam and the other by gas engines, each to cost complete $10,000, with liberal operating expense and depreciation, and showed that energy may be produced at 2 cents per kw-hour from a steam plant and slightly more than that from a gas plant. This is taking into consideration the use of heat from the exhaust steam for four months in the year. He said that the hot water used in the gas plant may also be employed for heating, as the heat may be augmented by making use of the hot air from the engine. The cost of production increases as the size of the plant decreases, he said, from the ideal that he had taken. On the other hand, the energy could probably be made to cost less with the use of larger plants.

It is true that the shafting and belts are more economical than individual motors, where it is necessary to group machines in certain ways to secure proper service from them. Where motors cannot be used to advantage, the only means is the shafting and belts.

George C. Bennett contended that there are isolated plants in operation in Cleveland that are producing energy at less than 1 cent per kw-hour at the switchboard. The central station charges, he said, are three times that much. He referred to plants operated by gas engines.

Mr. Adams said that more attention is now being given to the energy question than ever before, but he thought the most important feature of the subject is in the delivery. To that end he asked Mr. Houghton the cost for delivering energy per kw-hour at a point one mile away from the central station. The reply was to the effect that almost every station has a sliding scale to suit the conditions found in the various shops and factories and the number of hours per day that the motors are in use. Where motors are operated ten hours a day every day in the week, energy may be furnished more cheaply than where operated half time.

E. E. Miller said that in Canton a flat rate is used. In some comparatively small plants the energy is furnished at less than 2 cents per kw-hour. In one factory a gas plant, costing $16 per month to operate, was replaced by motors which are costing about $22 per month. Mr. Miller said he could not say whether the company can afford to furnish energy at 2 cents per kw-hour, but it is doing so. Bad engineering, another speaker said, is the worst feature of isolated plants. If plants are put in as they should be, energy could be produced cheaper than it can be purchased from a central station. A large stand-by service is usually maintained, in order that energy may be obtained in case of a break-down and this is a costly feature also.

In the case of some kinds of plants, as ore docks, it will not pay to have a special plant, as it would be in operation only about half of each year. However, Pickands, Mather & Company, of Cleveland, are using a small plant to operate ore docks. It remains to be seen whether it will really pay to use it. It was asserted that the small plants are abused by poor attendance or they would show much better results.

Prof. Fernald spoke interestingly of the use of gas producer gas engines in the operation of generating plants. The installation, he said, will run from 15 to 30 per cent higher than steam up to 1000 horse-power and about 10 per cent higher from 1000 horse-power to 5000 horse-power. In larger plants the cost will be about the same, as has been shown with a plant at St. Louis. The gain in the cost of operation will make up for the additional initial cost in from one and a half to two and a half years, he said, depending upon the size of the plant. One ton of coal will produce as much energy in a gas producer plant as two and a half tons in a condensing steam plant.

Prof. Fernald asserted that a plant can be operated with refuse coal, which is piled up by the hundreds of tons in the mining districts, at a negligible cost. Tests have been made along this line, and the manufacturers of gas producer gas plants are now getting ready to take them to the mines as a further test of what they will do. He also said that within two

years producer plants will be in operation on lake freighters. Much thought is now being given to their application to marine work, and one company has offered to fit out a vessel in order to test the machine for this purpose.

The use of gas producer gas engines for central-station service, he said, will greatly reduce the cost of producing energy. They may also be used to advantage for private plants. There are now over 300 installations in generating stations, largely among the coal plants of the country.

Dr. Bemis, superintendent of the waterworks at Cleveland, told of a visit to the large central station at Newcastle, England, where turbines have been put in. Energy is being furnished to several large factories at an exceedingly moderate rate. Here, it is believed, the energy is being purchased at a lower figure than it can be produced in private plants. In most cases in England, he said, small plants are holding their own. He believes that some time in the future central stations will take the business of the country, but they will have to do it at a much lower figure than is being demanded at present.

On Saturday forenoon the members visited the factories of the White Steam Automobile Company and of the Warner & Swasey Company, makers of telescopes, optical instruments and machine tools; Allyne Brass Foundry, large bronze and aluminum castings, and the Brown Hoisting Machinery Company, builders of hoisting and conveying machinery.

In the afternoon, after a meeting of the council, a business meeting was held. Ten new members were elected; it was decided to hold the next meeting at Columbus in May, the day to be fixed by the council. The following officers were chosen:

President, F. W. Ballard, Cleveland; second vice-president, W. C. McCracken, Columbus; treasurer, Mason Chilcote, Canton; members of the board of managers, Louis Kiser, of Cincinnati, and Mr. Haswell, of Bucyrus.

Following the business meeting, G. A. Jacobs read a paper on "Coil Insulation in Electrical Apparatus."

INSULATION OF COILS.

Mr. Jacobs treated the subject under three sub-divisions: First, the insulation on the wire; second, what might be termed the internal insulation of the coil, that is, the insulation which fills in between the turns of the insulated wire, usually after the coil has been wound; third, the external insulation which is placed on the outside of the coil and insulates it from the metal of the machine.

Mr. Jacobs illustrated his paper with a number of sketches and samples of insulation with the compound, which he described. The wires in all these samples, he said, are covered with plain cotton, and the compound forced in between them saturates the cotton, which really serves merely to separate the wires. Experiments show that cotton begins to break down at 125 deg. C. in the air, but in a vacuum the compound will not injure the cotton at 300 deg. Answering a question, Mr. Jacobs said that the compound may soften a little at 200 deg., but it strengthens the cotton insulation and will not break down at that temperature. The principal use of the insulating compound is to keep out the moisture, and under ordinary operating conditions treated coils are perfectly hard. For perfect insulation, however, the cotton must not be charred, but must remain intact. The speaker said that attempts are being made to secure a wire covering that will withstand a much higher temperature—something that may be heated to a red heat and yet remain perfect—but that such a substance has not yet been found.

Replying to a question, Mr. Jacobs said that he would advise the use of baking varnish wherever possible, instead of air-drying varnishes or preparations, since most of them will absorb moisture. An armature may be baked in a night and the cost of a baking oven is small. To further questions, he replied that almost all asbestos-covered wire is treated with varnish in the course of manufacture, but if not it should be so treated in using.

An address of H. M. Lane on "A Volumetric Study of Cast Iron" was delivered extemporaneously, and accompanied by lantern illustrations. The speaker went into the subject in detail and followed the chemical and mechanical changes from the pig to the cast, outlining the percentages of substances other than iron that enter into the composition.

Mr. Lane said that a Pittsburg concern has produced non-magnetic iron by combining tungsten and some other materials with the iron up to 8 per cent. He also talked of the cause of weakness in certain irons, which he said are often found in cupolo practice. Oxygen is the greatest enemy of the foundryman, he said, and if air is admitted in certain quantities the product may be porous and weak.

Court Criticism of Patent Office Procedure.

The U. S. Circuit Court of Appeals, sitting in New York, rendered a decision Nov. 15, reversing a decision of the Circuit Court of Appeals of the same district, in a case involving patents on the wireless cluster type of fixture. The litigants were the Benjamin Electric Manufacturing Company and the Dale Company. The decision of the lower court was rendered by Justice Holt, who had held that the Dale fixture did not infringe the patents at issue. Justices Lacombe, Coxe and Ward were on the bench when the case was brought up on appeal.

It appears that two patents were issued to Benjamin on the same date, having respectively the numbers 721,774 and 721,777. Three claims of the earlier patent were at issue and two claims of the later patent. The lower court held it to be very doubtful whether the second patent should not be regarded as invalid because anticipated by the first patent, under the rule that the patent numbered first takes precedence of the other, and rendered its decision on this rule. The comment of the higher court on this application of the rule is given below. The court stated that it concurred with the lower court as to the validity of the Benjamin invention only because by a combination of parts he was able to dispense with individual lamp wires and thus made the so-called wireless cluster a commercial success; but that three of the five claims at issue might be fairly construed to cover clusters which are not wireless and therefore these cannot be sustained. Then taking up the question of infringement, the court decided that two valid claims of the earlier patent were infringed, while the bill was dismissed as to infringement of the claims cited from the second patent.

The opinion is severe in its criticism of the lower court in adhering under the circumstances to the rule that the patent numbered first took precedence of the second patent, and drastic in its comment on Patent Office procedure. Quoting from a previous decision of the same bench, it said, "It would be a failure of justice if the patentee of a meritorious invention should be deprived of the fruit of his labors because an arbitrary rule of the Patent Office has brought about complications not contemplated." The opinion then proceeds as follows: "This case is a striking example of the unfortunate result of too close adherence to a rule. Benjamin came to the Patent Office with a meritorious invention—a simple one which was quite sufficiently described in a brief specification. The specification and the drawings showed his cluster-unit, by itself and also made a practical commercial article by the use of a cover and a switch, varieties of covers with and without bushing being shown. He asked for seven claims. The logical way would have been to include the genus and its varieties in the same patent, and half a dozen claims would have covered every possible combination which he was entitled to hold. But by the time that the Patent Office got through with him, Benjamin was the holder of four separate patents granted upon divisional applications split off from his original one, the four patents containing together 98 claims. It does not seem just that the patentee, who was powerless to obtain any modification of the rule for dividing application, should be made to suffer from such misdirected energy. There seems sufficient authority to warrant a construction, which will hold that these two patents, based on a single original application, isued on the same day, are to be treated as a single one, containing the five claims above quoted."

November Meeting of the New York Section of the I. E. S.

At the meeting of the New York Section of the Illuminating Engineering Society, held Nov. 14, Mr. W. S. Andrews presented an illustrated lecture on the early work of Mr. Edison on the incandescent lamp. The lecture was rendered particularly interesting by reason of the fact that Mr. Andrews spoke not only from personal knowledge, but from personal experience, because he had worked with Mr. Edison in the early days. Views were shown of the laboratory of Mr. Edison where there were developed many methods and devices that subsequently became standard in the electric lighting industry. Among the most interesting illustrations were those showing the development of the Edison bipolar generator from the long two-coil dynamo, through the shorter six-coil type, to the latest short two-coil machine, many of which have remained in continuous service up to the present time. In fact, so far as reliability is concerned, the old Edison bipolar machines proved equal to any modern generators. The first incandescent electric lighting system was the one installed on the steamer *Columbia*, which was used continuously for 15 years. Mr. Andrews related in an interesting manner the various difficulties that had to be surmounted before the lighting system was successful. Thus the first attempt to place the conductors underground failed because of the unjustifiable assumption that the electricity would prefer to follow the low resistance of the copper rather than the high resistance of the soil. When the bare conductors were placed in sand, a fair amount of success was obtained, but the insulation disappeared when moisture reached the sand. The third attempt, when the conductors were covered with tarred rope, brought complete success. It was stated that the early patents issued to Mr. Edison described in every essential detail the type of carbon-filament lamp that is yet in common use, although more than a quarter of a century has been spent in the introduction of minor improvements.

After the lecture, interesting talks were given by the following gentlemen, all of whom related instances of Edison's almost infallible "common sense," gathered from personal contact with the man, and most of whom had been associated professionally with Mr. Edison in his development work here and abroad: Messrs. T. C. Martin, C. L. Clark, J. W. Lieb, W. N. Stewart, W. S. Howell, F. J. Sprague, W. J. Jenks, J. D. Flack, R. W. Pope and Prof. W. D. Marks.

It was announced that the next meeting of the New York Section of the Illuminating Engineering Society will be held on Thursday, Dec. 12, at which time Mr. Bassett Jones, Jr., will present a paper dealing with architectural principles in illuminating engineering practice.

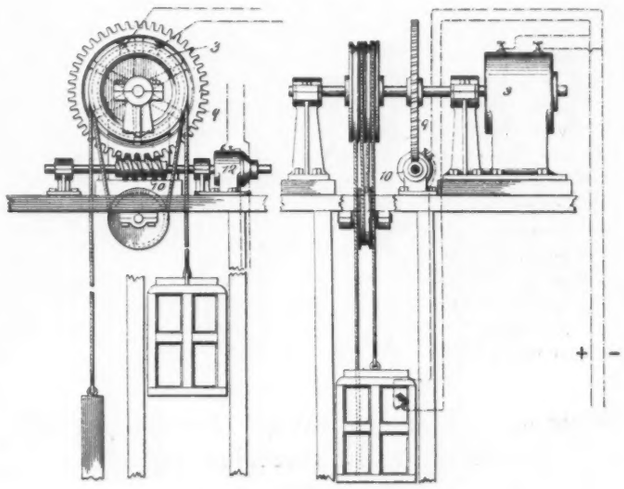
High-Speed, Electrically-Driven Elevators.

At the regular monthly meeting of the American Society of Mechanical Engineers, held on Nov. 12, in the Engineering Societies Building, New York, Mr. Charles R. Pratt presented a paper entitled "A High-Speed Elevator," which aroused no little interest. In it he described the gearless, 1-to-1, traction, electric elevator which is to be installed in the two highest office buildings in New York, pointing out its advantages over other types and also its defects.

The driving mechanism is located over the hoistway with a traction sheave and a brake pulley on the motor's armature shaft. The ropes from the car pass over this traction sheave, down under an idler sheave and again over the traction sheave and down to the counter-balance, giving two half traction turns over the traction sheave to drive the difference in weight between the car and the counter-balance. This traction has been found to be sufficient in ordinary passenger elevator service, especially in high-rise elevators, on account of the weight of the ropes and variable counter-balance chains or ropes, the latter leading from the bottom of the car to the bottom of the counter-balance, thus adding to the constant load on the ropes leading to each face of the traction sheave, thereby reducing the variable difference in traction load caused by the variable passenger load. The car speed of 600 ft. per minute requires a speed in the hoisting motor of 57 r. p. m. The loss of motor efficiency at this low speed is compensated for by the saving in friction loss due to the elimination of all transmission gearing between the motor and the ropes.

The brake pulley being about the same in diameter as the traction sheave, requires a frictional resistance of the brake shoe equal to the net load, or the same that is required by a safety device on the car to stop the car by gripping the steel guide rails. The usual reduction in speed is made by the dynamic action of the motor nearly to a stop; the brake, however, must be able to do this alone if required.

The elevator eliminates friction of worm, spur, screw, or rope and sheave gearing; excessive size of winding drums; dependance upon automatic limit stops and the inertia of a moving mass of metal and water in hydraulic elevators. The two distinct advantages that the traction elevator has over all others are unlimited rise and safe, normal limit stops. This type of elevator has been used for high-class passenger service but a few years, and although the author knows of no troubles in its operation or of accidents to suggest danger, he feels that the omission of positive speed control and holding power is too important a safety factor to be ignored in elevator service. He



DIAGRAMS OF ELECTRIC ELEVATOR MECHANISM.

suggests that this can be easily restored without detriment by replacing the brake pulley with a worm gear having its worm driven by an electric motor, called the controlling motor. Other changes necessitated would be as follows: The worm gear ratio should be such as to obtain the greatest efficiency in the controlling motor at the greatest range of speed by its field regulation. The construction of the worm should be such that it cannot be driven by its worm gear by making its angle of thread below 5 deg. and by using larger diameter thrust washers. The controlling motor should be connected in circuit with the hoisting motor so that the motors will synchronize with each other in starting, stopping and speed regulation.

The following advantages are claimed for this system: With both motors on open circuit, the car gradually and positively stops, because it cannot drive the worm gear. With the hoisting motor on open circuit and driving against gravity, with a heavy load, the fuse of the controlling motor blows and the motor stops; when driving in the direction of gravity or with a light load against gravity, the controlling motor drives the traction sheave under the control of the operator in the car and brings the car to its floor. With the controlling motor on open circuit, the fuse of the hoisting motor blows, and the car gradually stops. The controlling motor governs acceleration by its field regulation and the hoisting motor requires no finely

graduated starting resistance. The controlling motor governs the speed when driving with gravity and the hoisting motor requires no armature shunt. These advantages are obtained with the two motors connected in parallel; the same or possibly better results may be obtained if they are connected in series with slightly different action.

The action of the worm gear may be easily followed by reference to the accompanying illustration. On the shaft of the hoisting motor, 3, is a worm gear, 9, the teeth of which engage in the worm, 10, driven by motor, 12. The thread of worm 10, has such a small pitch that no amount of pressure against the threads of the worm could cause it to revolve. The hoisting drum is thus locked and no motion is possible until motor 12 revolves the gear 9 through the worm 10.

Motor 12 is compound wound and is connected in parallel with motor 3. The latter motor has a rating 10 times as large as that of motor 12, and the latter revolves 20 times as fast as motor 3. This high speed gives it a flywheel action that insures perfect acceleration in starting and stopping the car. In hoisting one switch closes the circuits of both motors simultaneously and both motors start together to hoist the load. At each change of speed one switch closes a circuit that makes the two motors synchronize with each other in speed. In stopping, a small friction brake can be used on motor 12 to bring it to a full stop promptly; but no brake is required to hold the car at rest or to keep it from exceeding its normal speed. In lowering, motor 3 is driven as a generator by the weight of the car and counterweight and motor 12 tends to drive the gear faster than the hoisting motor would allow it to be driven. This adds slightly to the load that drives the motor as a generator, but permits motor 3 to return energy to the line.

Failure of the circuit to either or both motors when lowering would not permit the car to increase its speed, and as oil buffers are provided to stop the car at full speed, safety is assured. The positive safety obtained by this method of control would compensate for some slight loss in efficiency. The synchronous operation of the two motors is simple. In hoisting, the smaller motor follows the larger motor and does its share of useful work. In lowering, the motors act as a booster set. The larger motor, therefore, retains the same functions as at present. It is assisted in hoisting and driven in lowering by the smaller motor, which has a slightly greater relative speed.

Meeting of the Chicago Section of the Illuminating Engineering Society.

A meeting of the Chicago section of the Illuminating Engineering Society was held Nov. 14, to listen to the paper by Messrs. V. R. Lansingh and C. W. Heck on "Fixture Design from the Standpoint of an Illuminating Engineer." Mr. Lansingh presented this paper in person. Among the suggestions made in the paper are the following: A reflector should be used over lamps placed in hemispheres. This may be of white asbestos, but preferably something with better reflecting surface. Several forms of hemisphere fixtures were shown. The same thing applies to art glass box fixtures. Curves were displayed to show the great increase in candle-power at all useful angles by the use of reflectors in ceiling fixtures of the bowl type. A suggestion was taken from the U. S. government specifications that small reflectors be placed over lamps used inside large enclosing globes. The use of reflectors inside of art glass brackets was recommended. He strongly recommended the use of fixtures with sockets pointing straight down, rather than at the common angle of 45 degrees, because of the difficulty of efficiently shading the lamp and covering the lamp filament if the lamp is placed at an angle.

Mr. Walter D. Steele, in discussion, expressed the opinion that the design of electric fixtures had been in the past too much in conformity with gas fixtures, as the electric fixtures did not have the limitations of gas as to location. He advised placing them higher and in fixtures not in conformity with the conventional gas designs.

Mr. S. M. Bushnell endorsed the neat appearance, good diffusion and good illumination secured with the ceiling hemisphere when installed with a single lamp and reflector, as recommended in the paper. He also emphasized the necessity of pointing sockets straight down, in order that the lamp filament may be easily hidden. As the efficiency and light intensity of incandescent filaments get higher year by year, this becomes more important.

Mr. Peirce Anderson, of D. H. Burnham & Company, speaking from an architect's standpoint, thought it desirable to eliminate the fixture entirely if possible, as a lot of protruding fixtures interfered with the effect. He described at length the provision made in the new Union Station at Washington for lighting the large waiting-room, and also the concourse, with but few exposed sources of light.

Mr. E. W. Lloyd thought that while it was a good plan to get away from the conventional gas-fixture idea, nevertheless, for reasons of cost and convenience, such fixtures must necessarily be common for a number of years to come, and the study of efficient arrangements for use with such fixtures was important. He thought the society should have more papers of this kind, taking up practical details.

Mr. J. R. Cravath emphasized one practical detail frequently forgotten and by many unknown, of the importance of an asbestos disc used at the neck of all enclosing globes to keep out dirt. Such discs are seldom seen, but are very important, both on account of looks and service. He also told a number of stories to illustrate how important it is that anyone planning a job of lighting should watch carefully to see that specifications are carried out in detail; otherwise, by slight changes which are very likely to be made by the fixture dealer or fixture hanger, many of the results aimed at may be defeated.

It was voted to devote the Dec. 12 meeting to the subject of "Special Lighting of Downtown Streets," as the business men of several streets in Chicago are contemplating special spectacular lighting, and there is general interest in the subject at the present time in Chicago.

CURRENT NEWS AND NOTES.

THE UNIVERSITY OF MONTANA Branch of the A. I. E. E. at its last meeting elected the following-named officers: Prof. Robert Sibley, president; Mr. James Slack, vice-president; Mr. Sidney R. Tuch, secretary, and Mr. Chas. Barret, treasurer. The branch has a large active membership and many interesting meetings are being planned for the winter.

DAM IN NIAGARA RIVER.—It is stated that plans for a submerged dam across Niagara River, just above the Falls, are being considered by the International Waterways Commission, and a favorable report will probably be submitted to Congress. Members of the commission believe this scheme will restore the lake levels, and it is said that the dam will not affect the falls.

PITTSFIELD SECTION, A. I. E. E.—The second meeting of the Pittsfield section was held Nov. 14, in the large dining room of the Hotel Wendell. One hundred and ten members were present and listened to a very clear and interesting address by Mr. H. H. Barnes, Jr., on "The Practical Side of the Curtis Steam Turbine." The lecture was illustrated with a large number of lantern slides, showing details of construction. Mr. Barnes brought out the great economies which have been effected by the use of these machines both in the matter of space and steam consumption. The remarkable growth of this business was shown by figures giving the total kilowatt capacity installed at the various periods during the four and one-half years in which these machines have been developed. The Pittsfield section has adopted the plan of admitting to its membership "local" and "student" members. The membership has been increased from about 20 at the beginning of the season to about 200, and great interest is being manifested in next meeting will be held on Dec. 6.

PLATINUM DEPOSITS.—According to a recent consular report extensive plantinum deposits have been located in the province of Lloro, Colombia. The government has assumed a monopoly of the utilization of these deposits.

INDUSTRIAL FREEDOM.—At Norfolk, Va., on Nov. 16, the American Federation of Labor by a vote of 154 to 50 refused to place itself on record as favoring the government ownership of railways and mines, the question having come up on a resolution offered by Herbert Crampton, of the Amalgamated Carpenters, to amend the economic platform adopted at Minneapolis last year so as to include railroads and mines in the favorable action taken at that time on the "nationalization" of telegraph and telephone properties. The opponents took the ground that government ownership of mines and railways would prevent all strikes, no matter how peaceably they might be conducted, and that with a federal government opposed to labor it might prove a death blow.

MARCONI STATION BURNED.—Special advices from Nantucket, Mass., state that the Marconi wireless station at Siasconset was destroyed by fire on Nov. 15. This station was the first to be established on this side of the ocean for commercial purposes, principally for reporting vessels. The fire destroyed the engine and engine house, a large amount of wireless apparatus, the lodging house of the operators and several smaller buildings. The big mast escaped and can easily be connected with the new instruments. The loss is between $6,000 and $7,000. The Marconi Company has begun prompt measures to restore its wireless station at Siasconset, Mass. A new equipment has been ordered and early restoration of the plant is expected. Meantime, the service will be carried on through South Wellfleet.

CHASING CORPORATIONS.—Before the National Grange at Hartford, on Nov. 13, President Mellen, of the New York, New Haven & Hartford Railroad, which has lately been applying electricity to its system, made a very vigorous address in which he characterized the late attacks on corporations to a drunken debauch, and said: "The country has been having the time of its life. We have been chasing the corporations until it has got on our nerves; we are tired of the life we have been leading; we have got to rest. When we awake it will appear to have been a costly dream. When we have mended the smashed furniture, the broken crockery, we will lay by for a time and accumulate the wherewithal to repair the waste of our debauch. We may not think quite so well of ourselves for some time, our leaders will not look quite so large in our eyes again, but we forget quickly and we can only forget the whole miserable business after we have paid the bill and have well learned our lesson. There will be a measure of compensation, not without its value."

AGAINST ELECTROCUTION.—It is announced from Berlin, Germany, that Prof. Freudenthal, the distinguished German criminologist who went to New York to study the use of electricity in carrying out death sentences with a view to the adoption of the system in Germany, advises against its substitution for hanging and decapitation now in vogue here. Prof. Freudenthal witnessed an execution by electricity at Auburn Prison, New York. He says that the chair is preferable to the gallows or the block from one standpoint of the spectators, because the human agency whereby death is caused is not so apparent, but that this advantage does not compensate for the torture the spectators suffer in the uncertainty as to just what moment death occurred, or if it has occurred at all. On the occasion on which Prof. Freudenthal was present the spectators had a distinct impression that the heart of the condemned man continued to beat after the first application of the voltage, which was followed by a second application. Prof. Freudenthal also finds that the length of the torture suffered by the condemned makes the adoption of electricity undesirable in Germany.

NIGHT IN LONDON.—We should alter two of our impressions of England, according to Mr. Thomas A. Janvier—our idea that London is dark or gloomy at night, except in a few neighborhoods, and our "belief in English phlegm." "Eagerness—to get somewhere or to do something, and to get it or do it in a desperate hurry—is what one sees by night (and by day, too) in London streets," writes Mr. Janvier in the December number of *Harper's Magazine*. As to the lights o' London, Piccadilly Circus is the heart of them—"an all-pervading electric glare." Even London Bridge is brightly lighted. The photographs of London by night accompanying the article, show quite wonderful effects from the camera. They were made by Arthur Hewitt, and are reproduced in tint. Paris is often spoken of as "La Ville Lumiere," but is a hollow mockery in that respect, for only one or two thoroughfares are brilliantly lighted. The rest are sunken in Cimmerian gloom, and the same might be said of the London suburbs.

AMERICAN TRACTION PROGRESS.—A special cable dispatch from Berlin, of Nov. 16, says: "Herr Wittfield, privy councillor and the electrical expert of the Prussian railway ministry, who took a commission of experts to the United States recently for the purpose of studying electrical transportation problems, said to-day: 'America's progress in electrical rapid transit since my previous visit there is astonishing—amazing. Not only have the roads for municipal rapid transit been greatly increased, developed and perfected, but electricity is applied more and more to standard gage roads. It interested me especially to see that the practical Americans are now using almost exclusively the single-phase alternating current. The continuous-current roads which predominated in my previous visit are dropping further and further into the background. The American roads are built excellently. It is astonishing to see with what simple means the Americans get splendid results, even where money is lacking. We were astonished at the gigantic development of electrical roads in Indiana and the thinly settled states, like Oregon.' Herr Wittfeld added that the visit of the German experts will have practical results. Their observations in the United States will be utilized in electrifying the Berlin and suburban roads. Work on the plans of these improvements has been begun, but it will require several years to finish them."

INTEREST IN STOCKS.—One of the hopeful outcomes of the recent financial depression has been the increase in the number of stockholders in all the great corporations, even where probably least expected. For example, Western Union, which has for many years been regarded as one of the best investment securities on the market, and is generally held on to very tightly has shown almost an increase in the face of a slump in price during the year from 86 to 63. The number of new accounts opened during the quarter previous to Oct. 1 was 434, or a gain in number of stockholders of 118. For the first month of the new quarter since Oct. 1 the number of new accounts opened has been 407, or a gain of 175. This makes the gain for one month larger than that for the whole preceding quarter. This is particularly significant in view of the fact that the total number of persons holding Western Union stock is approximately 14,200. The exact figures for the American Telegraph & Telephone Company, another standard industrial, could not be obtained, but the representatives of the company in New York stated that their gain in stockholders taking small blocks of shares was running up into big figures. He said: "This is something that we have been trying to bring about for a long time. It has so happened with us as we have issued new stock we have taken over new properties that we have found the principal stockholders loaded up with about all that they could hold, and we have had to canvass to get other holdings. But once we can get the people in and get them interested in buying a solid interest-paying security as an investment everybody will be pleased." The *Saturday Evening Post* has just published a couple of interesting articles on the promise of telephone investments.

FRANKLIN.—A very fine portrait medallion of Benjamin Franklin, modelled by John Flaxman, R.A., and reproduced in "jasperware" by Josiah Wedgwood, will be the frontispiece of the Christmas *Scribner.*

CARELESSNESS WITH FIRE.—It is stated that the United States fire bill for crime and mischief is far less than the bill for carelessness in handling heating and lighting apparatus, matches, cigarettes and firecrackers. For their carelessness in playing with fire in the 21 years people of the United States have paid $266,340,058, or 12 per cent of the total loss, if the itemized percentages for the years given hold for the entire period. This source of fires is more than double the total fire bill for electric wires, lightning, cyclones and earthquakes prior to the San Francisco disaster. Even forest and prairie fires can be added without equalling the loss from carelessness.

ARGUMENT OF DESPAIR.—Governor Guild, of Massachusetts, speaking before the Cleveland Chamber of Commerce last week said: "The one danger that most business men view with horror is socialism, the idol that has wrecked one republic after another and that crouches to-day like an incubus upon the neck of Australia. The strongest argument for government ownership, the argument of despair, is that State ownership is the only relief from graft. The man who is doing more for socialism, communism and anarchy to-day than any other is the highly respected business man who for any reason buys legislation. Graft could never exist but for the man behind the grafter."

MUNICIPAL FIRE ALARMS.—The Philadelphia *Ledger* says of local conditions in its city, under municipal ownership: "Philadelphia's fire-alarm apparatus is a quarter of a century behind the times; it is impossible to send an alarm from many of the boxes, while the 3300 cells on the ninth floor of the City Hall that form the storage battery for the operation of the police and fire calls will be thrown upon the junk heap within a month as worthless rubbish. So antiquated is the method of carrying the cables into the City Hall that a slight accident could throw out the entire system and not one fire alarm or police call box in the city could be used. There is no emergency main into the building, such as every large business house provides, and in case of accident to the power plant in the basement of the City Hall, every fire house in Philadelphia would be cut off from communication with the boxes." Exactly similar conditions prevail in New York's fire and police telegraphs under municipal management, as revealed by recent investigations.

NEW TRAINING SCHOOL.—At Albany, N. Y., an appropriation of $10,000 has been made to start a boys' manual training and grammar school, the first of its kind in the country. In this school, mathematics, as a special study, will be entirely omitted, and in its place brass and iron working and casting will be taught. The measurements and planning necessary for the initial work will teach the boys all the principles of arithmetic and elementary algebra. At the end of the course of study in the manual training school the graduates will have mastered sufficient mathematics to enter the high schools with those who have attended the regular grammar schools, in addition to having learned a handicraft. The sponsor for the scheme is Mr. James M. McElroy, the well-known inventor of the electric car-heating and train-lighting systems. Mr. McElroy claims that working with brass and iron holds the interest of the boys, so that they learn more mathematics in connection with the manual training than is possible in a regular grammar course. The details of the plan have been worked out from the methods used in the technical schools of Sweden and Germany.

PLATINUM PRODUCTION.—In 1906, 1439 ounces of platinum were produced in this country as against 318 ounces in 1905 and 200 ounces in 1904. The imports of platinum during the year 1906 were valued at $3,788,759, as against $2,173,623 in 1905, distributed as follows: Unmanufactured, 1267 lbs., valued at $390,989; ingots, bars, sheets and wire, 10,227 lbs., valued at $3,210,131; vases, retorts and other apparatus, vessels and parts thereof for chemical uses, $186,398; manufactures of, not specially provided for, $1,241. The price of platinum rose from $20.50 per troy ounce on Jan. 6, 1906, to $38 on Nov. 17, remaining at this figure until the end of the year, after which there was another slight rise in price. In February, 1907, for the first time, a distinction was made between ordinary platinum and hard platinum; that is, platinum rich in iridium and osmium, considerable iridium being allowed to remain alloyed in the platinum of the ingots. Such hard platinum was quoted at $41 per ounce on Feb. 23, and this price held until April 6, 1907, when the placing on the market of more than 100 lbs. of platinum by a new producer interested in American developments checked the advance, and on May 4, 1907, ordinary platinum was quoted at $32 and hard platinum at $35. Then a gradual decline set in, and the present price (October, 1907) is $23 for ordinary and $25 for hard platinum.

TELEGRAPH TRANSMITTER.—A patent was recently issued to Mr. J. C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, for a keyboard telegraph transmitter designed primarily for use in connection with his page printing telegraph system, which has been referred to in these columns. The transmitter, however, is not limited to use in connection with any particular system of printing telegraph, nor to any particular code of transmission, but is applicable to telegraphic transmission in general, and may transmit according to any code desired. It comprises a number of adjustable stops or circuit-controlling devices adjustably mounted on a rotatable drum, and arranged to be adjusted in position according to the character to be transmitted. It also comprises contact mechanism to be operated variably according to the variable adjustment of the circuit-controlling devices, so as to transmit the different signals. Mr. Barclay's invention consists in novel and improved means for operating the transmitting contact mechanism variably, according to the character to be transmitted, besides several other features, and the objects of the invention are to improve and simplify keyboard telegraph transmitters, to render them certain and rapid in operation; to adapt them for the employment of approved types of transmitting contact mechanism; to avoid unnecessary delay between characters transmitted and to make the machine easy to operate, easy to inspect and keep in order, simple, rapid in operation and relatively inexpensive.

MORE LIGHTING INQUIRY.—Although the electric lighting situation was thoroughly investigated only three years ago by public authorities, with a record of several bulky volumes, some members of the Public Service Commission are anxious to go through this expensive performance again. The lighting inquiry, if undertaken, will be in charge of Commissioner Maltbie, who is understood to be anxious for this opportunity. The first company called upon to produce its books and submit to the examination of its officials will be the Edison. Following that, each of the subsidiary concerns of that company will be taken up and the situation in Manhattan, in its entirety, made a matter of record. The question of rates will receive special attention. After the Manhattan situation has been disposed of the commission will take up the service in Brooklyn and Richmond. The rates will also be considered, and it is declared that there is a strong probability of the commission seeking to have the rates in all the boroughs lowered by legislative enactment. It is said that the commission has received a number of complaints that the electric lighting companies insisted on yearly contracts. It is the aim of the commission to do away with this practice entirely. Another matter that it will give particular attention to is the "break down" service to business buildings which have their own plants but which have to depend on the Edison or some other company in case of a mishap to their own plants. The lighting companies obviously could not afford to put in plants worth millions of dollars in the hope of doing chance business for one hour.

Hydro-Electric Generating Station on the Waipori River in New Zealand.

THE amount of power available for hydro-electric development in the rivers of New Zealand is stated to b e approximately 3,700,000 horse-power. While there are several small streams being utilized for generating electrical energy, the most important hydro-electric station is that of the Dunedin City Corporation, on the Waipori River, in the province of Otago. This station besides being the largest, has the distinction of being the only high-tension transmission plant in Australasia.

INTAKE.

At the point where the Waipori River leaves its last elevated plateau and begins its final rush toward the sea, is the intake, the height of this above sea level being 1125 ft. From this point the river rushes in numerous cascades through a vertical height of 700 ft. in less than 2 miles. The length of the river above the intake is 22 miles and the catchment area of the watershed is about 95 sq. miles. The discharge at the point of intake has varied from a maximum of 50 cu. ft. per square mile to a minimum of 0.4 cu. ft. per square mile.

The location of the intake was well chosen and advantage was taken of a projecting spur of rock through which a tunnel 22 ft. in length was cut. This tunnel leads into a wooden flume. On the opposite side of the river a similar spur forms an excellent key to the dam. The rocks also provide an easy method of handling the head-gates. The tunnel is rectangular in section, being 8 ft. by 4 ft. at the intake and tapering to 6 ft. by 4 ft. at the junction with the flume. Each head-gate is 4 ft. by 4 ft. in size and is operated by rack, pinion and pawl with ratchet levers. The dam is constructed of rock-filled cribwork, 76 ft. long at the crest, 15 ft. in depth, with a top width of 10 ft., and a bottom width of 32 ft. The timber used was obtained in the vicinity, and none of the logs are less than 8 ins. in diameter at the small end. The first bay of logs was run longitudinally with the stream, and fastened to the bedrock by iron dowels run in with neat cement. The next tier was run at right angles to the first, the logs being finished with an adz to present a neat seat at each intersection. The space was then filled with hand-packed rubble as large as could be conveniently placed in the structure. A spillway has been constructed on the opposite side to the intake, which tends to divert the water clear of the head-works during heavy floods, and an 18-in. scour pipe has been provided in order to draw off silt accumulations. The object of the dam was to cause the deposit of material carried in suspension, the material thus deposited to form a water-tight structure, and to reduce the pressure on the crib-work to a minimum.

FLUME.

The conduit for the water embraces all the features usually met with in an undertaking of this class, viz., earthworks, tunnels and pipes, and the total length from intake to water wheels is 11,484 ft.

The conduit from the intake to the penstock is wooden rectangular fluming, except where it passes through the tunnels, built upon a bench 10 ft. wide, mostly excavated out of solid rock. Where the flume crosses creeks and gullies it is carried on masonry piers. It is 6 ft. by 4 ft. in the clear, and has a uniform gradient of 8 ft. to the mile. The joints in the longitudinals are butted and covered by battens 3 ins. by ½ in., under which is placed a 3-in. strip of tarred felt, the joint having received a coat of tar applied hot, and all butt joints were run in with boiling pitch. The length of wooden fluming is 8976 ft., and the six tunnels aggregate 726 ft., total 9702 ft. Four spillways are provided in this distance; these are for the purpose of facilitating repairs to the flume. The flume is constructed of mountain birch, an abundance of which exists in the locality. A saw-mill was erected in the vicinity and worked by an impulse wheel, under a head of 120 ft., located on the bank of the river, and the sawn timber was hauled 3170 ft. by cable

FIG. 1.—VIEW OF INTERIOR OF WAIPORI POWER HOUSE.

tramway, rising 1100 ft. in that length. Four miles of wooden tramway were laid through the bush, on which the logs were hauled by horses to the mill. Nearly 1,000,000 ft. of timber was used in the flume construction, and 400,000 ft. of sapwood was cut into suitable sizes for building purposes. The life of the flume is estimated at from 10 to 12 years, but before the expiration of that time, no doubt, a tunnel about 5000 ft. long will be constructed through the hill to conduct the water to the penstock.

TUNNELS.

The tunnels, which are cut through the various spurs, vary in length from 295 ft. to 20 ft., and they are made slightly larger than the flume. One novel feature in the construction of the tunnels consists in increasing their capacity by dropping the invert level 7½ ins. at the inlet and rising correspondingly at the outlet. It was found that owing to the decrease of frictional surface the discharge was increased by this means nearly 15 per cent.

Three spillways are operated by rack, pinion and pawl, while the fourth, from which all water discharged into the pipeline is regulated, is operated by a revolving screw, the nut being firmly fixed in a yoke piece which has two long arms with a cast-iron ball weighing 30 lbs. at each end. As the plane of the gates is at right angles, one leading to the spillway and the other leading to the penstock, the race-man is able to stand in a position so as to operate both gates simultaneously with the assistance of the centrifugal force obtained by the cast-iron balls.

In order to free the water of all materials carried in suspension two catchment basins, to intercept stones, etc., have been constructed, each having a capacity of 53 cu. yds. of silt. The flume terminates at the penstock, which is constructed of concrete, and is 13 ft. long by 9 ft. wide and 10 ft. deep below the sill of the flume. Two pipes are built into the penstock, each 42 ins. in diameter and provided with 6-in. air vent pipes, located on the pipe side of the main gates. Before the water enters the penstock it passes through two gratings, 20 ft. apart, one formed by wrought-iron bars, 1½ ins. apart, lying at an angle of 45 deg., and the other of galvanized wire netting, 1½-in. mesh, at an angle of 60 deg.

PIPE LINES.

The pipe line presents some features of interest, on account of the deviation from the usual practice. The steel pipes vary from 42 ins. to 36 ins. internal diameter and vary in thick-

FIG. 2.—DAM ACROSS THE WAIPORI RIVER.

ness from ⅛ in. at the penstock to ½ in. at the power station end. The length of the pipe line is 1776 ft. The pipes are manufactured from "soft open hearth" steel plates with a tensile strength of between 52,000 and 56,000 lbs. per sq. in. The rivets are of similar quality with a tensile strength of between 44,000 and 50,000 lbs. per sq. in., all materials being submitted to the usual bending, punching and cold hammering tests.

The pipes were made in 20-ft. lengths in the shop and were subjected to a test 25 per cent in excess of that given, after which they were cleaned by sand-blast, then heated to a temperature of 300 deg. F. and dipped for 15 minutes in a bath of asphaltum mixture, containing 1½ per cent of pure linseed oil.

The building of the pipe line entailed a large amount of labor and risk to men and horses, owing to the inaccessibility of the country. After being placed in position in the trenches the pipes were jointed and hand riveted, afterward being caulked both inside and out; they were then covered with soil to a depth of 2 ft. 6 ins. to dispense with expansion joints. The variation in temperature of the water between summer and

FIG. 3.—WAIPORI POWER HOUSE, HILL-TOP TOWER AND ENVIRONS.

winter is not more than 15 deg. F., and the expansion due to this difference will not be more than 2 ins., which will be taken care of by the vertical angles in the pipe line. Six anchorages, four of which are of solid concrete blocks, 6 ft. x 4 ft. x 6 ft., prevent the line from creeping. Five air valves of the triple cluster type are provided with shut-off gate and extension pieces to allow the influx and efflux of air, the balls being of hard wood with rubber seats. Five manholes are placed in the line to facilitate field riveting and inspection.

Owing to the physical features of the country it was found impossible to select a line wholly below the mean hydraulic gradient, and recourse had to be made to a tunnel at the lower end. This tunnel is 187 ft. in length, with a gradient of 1 in 3½, and large enough for three pipe lines, thus providing for future extension. At the mouth of the lower end of the tunnel the last section of ½-in. plate pipe is attached to a cast-iron "Y" branch piece, dividing the water into two 22-in. cast-iron pipes, each to carry 20 cu. ft. of water per second, one branch for each unit. On each end of the branch of the "Y" a main 22-in. gate is placed with a 4-in. by-pass. The valves are enclosed in a tower, as they are operated by fine thread spindles, which require 2500 turns of the hand wheel to open or close them; a motor is installed to operate these. The rest of the pipe line is of cast iron, each leg of the 22-in. branch being 80 ft. long, bifurcating by a cast-iron "Y" piece into two 14-in. branches, each leading to the nozzle of the impulse wheel. Each 14-in. branch is controlled by a 14-in. gate valve with by-pass. The cast-iron pipes were made of best gray iron, having a tensile strength of not less than 18,000 lbs., and were cast vertically in 6 ft. 6 in. lengths, weighing 2800 lbs.

It was, of course, necessary to erect the foundations for the engine beds before the pipes were laid, and considerable difficulty was met with in having to connect rigidly with two fixed points in the pipe line. The closures were made ¼ in. short and the final joints were run in with lead caulked against a wrought steel band shrunk over the flanges. In the terminal pipe two extension pipes were placed, one being a 6-in. branch to operate the exciter units, and the other a 4-in. branch leading to the air receiver. The exciter pipe line is so arranged that

any two of the three exciters may be operated in parallel with the same hydraulic head.

All cast-iron pipes were tested hydrostatically to a pressure of 450 lbs. per sq. in., and the valves to 500 lbs. per sq. in. The joints are made with round rubber high-pressure gaskets, the flanges being recessed for that purpose.

Generally the whole layout of the pipe system is a departure from that usually adopted, more particularly in respect to the entire absence of receivers at the back of the power house. The deviation of water is made by the "Y" branches. The weight of the column of water in the pipes is about 470 tons, which at full bore moves with a velocity of 5.66 feet per second; and in order to provide against accident due to shock from water hammer, an air receiver has been installed which consists of a shell 30 ft. long by 36 in. in diameter. The air pressure is maintained equal to that in the pipe line by an air compressor operated by a 10-hp motor, and the water is covered with a layer of oil to prevent aeration of the former. The capacity of the receiver was calculated to absorb the shock of a sudden stoppage of flow from one jet of the four main pipes in six seconds at full bore; the standard working pressure being 288 lbs. per sq. in. The receiver reclines at an angle of 26 deg. from the horizontal, and is provided with an automatic float which operates the controller of the compressor motor.

The receiver was placed at the end of the malleable line because it was impossible to place it nearer the nozzles; the cast-iron pipes had, therefore, to be made sufficiently strong to resist the shock arising from water hammer.

As previously mentioned, the main supply of water carries a large amount of sludge in suspension, which renders it unsuitable for the operation of the hydraulic governors. A supply of clear water was obtained from a small creek giving a hydraulic head of 400 ft. at the power station. A small concrete dam 8 ft. high to the sill of the spillway was constructed across the bed of the creek, and the water conveyed by a 4-in. pipe line, 1807 ft. in length, to the governor. This pipe line is provided with the necessary air valves, gate valves and stopcocks, and is buried and securely anchored. It is tapped at a height of 250 ft. above the power station to supply the engineers' residences and fire hydrants, and in addition to supplying the governors the water is also used for cooling the transformers.

The maintenance and operation of the flume are looked after by one man, who has been provided with a small cottage lo-

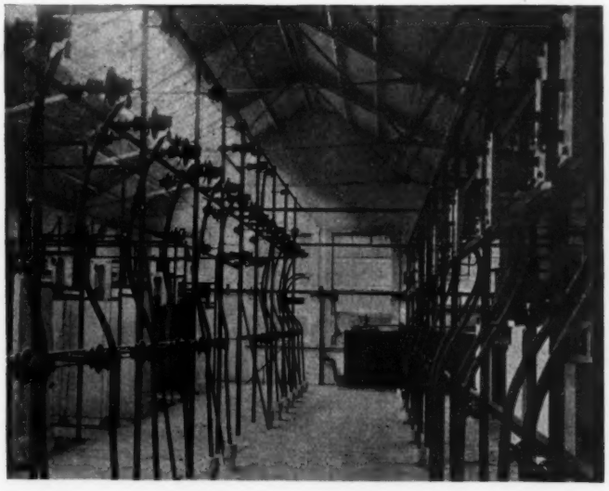


FIG. 4.—SWITCH ROOM, SHOWING 35,000-VOLT OIL SWITCHES AND BUS-BARS.

cated near the penstock. It is this man's duty to record the water passing through the flume and over the dam and to patrol the whole length of the flume twice per diem. His residence is connected by telephone to the power station, and there are also telephone stations along the flume at each spillway and one at the intake, and the raceman reports to the power station from each point.

When making the efficiency test the water was measured by passing it through a square orifice. The head and aperture were accurately measured and the coefficient of discharge used was 0.619, and the results agreed with the measurements of the water over a weir. The amount of water used during the experiments was 25 cubic feet per second, and allowing for frictional losses, etc., the total theoretical horse-power at the power house was 2185. This included the water for the main unit and exciter. The spouting velocity at the nozzles was

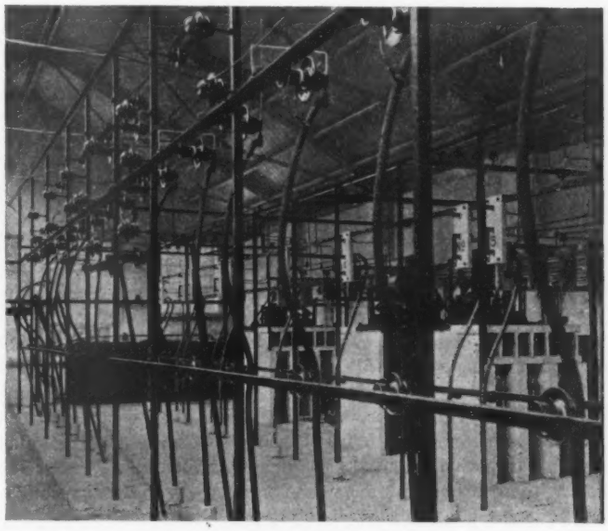


FIG. 5.—SWITCH ROOM, SHOWING 2400-VOLT OIL SWITCHES AND BUS-BARS.

12,360 ft. per minute; the peripheral speed of the water wheels being 5945 ft. per minute.

POWER HOUSE.

An ideal site for the power station was selected on the bank of the Waipori River. The building is constructed of concrete reinforced with steel rods; the metal, gravel and sand for the concrete were obtained from the opposite bank of the river and consequently only the cement and reinforcing rods had to be transported from Dunedin.

The power station building is 100 ft. long by 64 ft. in width (internal dimensions), and a temporary wall has been constructed at the down stream end to allow of future extension. Before commencing the work of clearing the site for the foundations it was deemed advisable to clear the bed of the river in front of the power station of the large rocks and boulders so as to provide a clear channel for the water in flood time. This dangerous and arduous work took several months to complete, and the bed of the river was cleared for a length of 528 ft., the result being that the normal level of the water was reduced 6 ft., thereby considerably reducing the cost of the power station foundations, as the floor level would have been 6 ft. higher if this work had not been carried out.

Concurrently with the work of clearing the river bed the construction of a training wall at the up-stream end of the power station was proceeded with to divert the flood waters from the power station site and to form a permanent protection to the foundations from erosion during time of floods.

The foundation for the wall of the building on the river front was taken down to the rock bottom 16 ft. below the bed of the river, and is 8 ft. wide at the base, tapering to 4 ft. wide at the engine room floor level, which is 6 ft. above the highest known flood level.

The power station is divided into two portions: the front portion forms the engine room and is 100 ft. long by 30 ft. wide; the back portion is 100 ft. long by 29 ft. wide and has two floors. On the ground floor adjacent to the engine room is the low-tension bus-bar corridor, which runs the whole length of the building and is 7 ft. 6 in. in width. At the rear of this is the transformer room, which is 63 ft. long by 12 ft. wide, and at the

rear of the transformer room is the high-tension bus-bar corridor, which runs the whole length of the building and is 9 ft. wide. These compartments are divided from each other by concrete walls, which also form the support for the floor of the oil switch room above, which contains the high-tension and the low-tension remote control oil switches, the low-tension in this case being 2400 volts. The walls and floor of the oil switch room are constructed of reinforced concrete, the floor being calculated to carry a distributed load of 40 tons. At the down-stream end of the building, in the rear of the high-tension bus-bar corridor, is the lightning arrester annex, which is 29 ft. long by 5 ft. 6 in. wide.

The main walls of the engine room carry a 15-ton traveling crane, which runs on concrete girders reinforced with steel rods and partly supported on concrete corbels. The roof is constructed with framed iron principals at 12 ft. 6 in. centers and is sheathed with thin boards, felted and covered with galvanized iron. The engine room and the oil switch room are lighted by means of skylights which run the full length of the building, and there are also large windows at the up-stream end. The foundations for the machinery are carried down to bed rock; they are constructed of solid concrete and are entirely independent of the main building. The cast-iron pipes conveying the water to the engines are carried through the building on independent foundations.

There are two main generating units, each unit consisting of one General Electric, 1000-kw, 2400-volt, 50-cycle, three-phase generator, running at 429 r. p. m. The regulation at full load and unity power-factor is 7 per cent, and with 1000 kva and a power-factor of .75 the regulation is 15 per cent. The efficiency is 95.25 per cent at full load. The

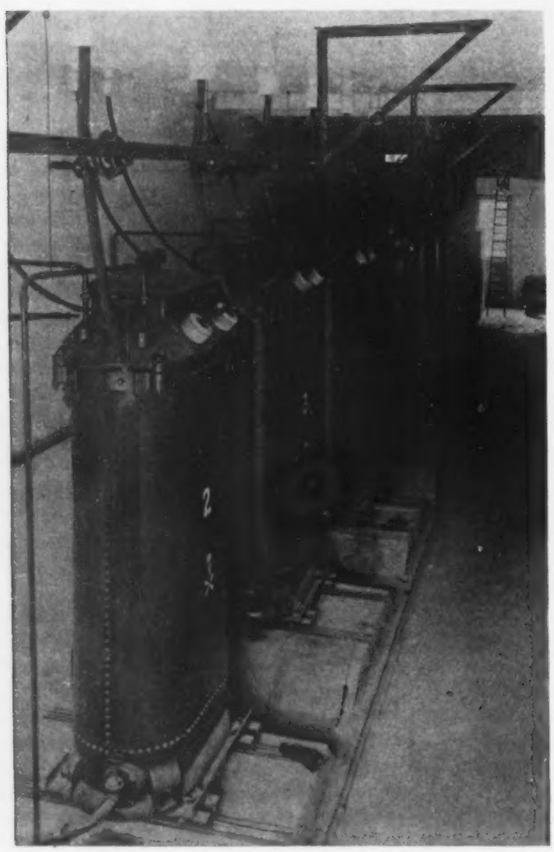


FIG. 6.—TRANSFORMER ROOM, SHOWING STEP-UP TRANSFORMERS.

generator is driven by two Pelton wheels, each 4½ ft. in diameter, one at each end of the shaft. Leading to each water-wheel is the 14-in. pipe, so designed as to increase the velocity at the nozzles. The flow of water is controlled by the main 14-in. gate valves on each branch, which, under operating conditions, are left wide open, and the regulation is adjusted by means of movable needles within the nozzles. The needles are of bronze and operated by worm gear and hand wheels, so that the quantity of water flowing through the nozzles varies according to the area of the concentric aperture between the needle and nozzle tip, the latter being 5½ in. internal diameter.

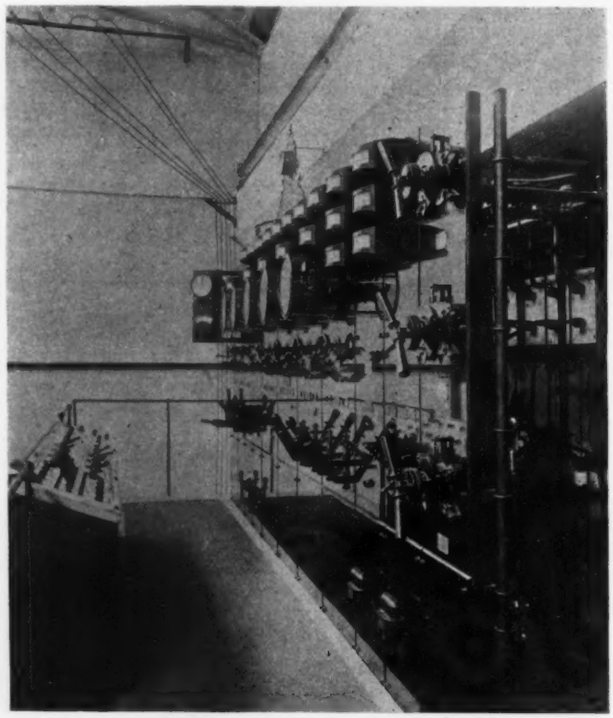


FIG. 7.—MAIN SWITCHBOARD IN POWER HOUSE.

When operating at full load the radial space is ⅞ in. The needles are provided with heavy reaction springs to ease the effort required to increase the annular opening.

Under full-load conditions the nozzles are at the top position and the jet impinges on the center of the buckets. At no load the jet is quite clear of the buckets and impinges against a heavy iron baffle plate which deflects the water into the bottom of the tail race. The jets discharge across the river and strike the opposite bank. They act as an ejector and special ducts are led into the discharge to admit air. The whole of the solid casting forming the nozzles is attached to the main pipe by a ball and socket joint, and is free to move in a vertical plane through an angle of 4 degrees. The nozzles are raised and deflected by means of a system of levers, cut gearing, and rack shaft operated by the hydraulic governors, which are of the Lombard type. The deflecting portion of the nozzles is counterbalanced by hydraulic pressure, so that quick action can be secured from the governor on account of the absence of inertia in heavy counterbalanced weights.

The governors are provided with electric-control motors operated from the table switchboard, which admit of instantaneous control of the speed of the water-wheels. This control is of great advantage when synchronizing. The regulation of the governors is sensitive and does not vary more than 4 per cent from no load to full load and from full load to no load. When the load is thrown off, the jets are deflected clear of the buckets.

The Pelton wheels are capable of driving the generators at 50 per cent overload, but they are designed to give the best efficiency at full load. The buckets are made of the highest grade cast semi-steel, and the wheels are guaranteed to safely withstand the highest run-away speed attainable under the effective head of 665 ft. without damage with the nozzle adjusted to give the maximum stream. The nozzles are pivoted on heavy trunnion pins and the ball joints are leather packed with oak-tanned leather laid in tallow. A reaction strut is provided for

relieving the fulcrum bolts from thrusts which are taken up on an independent journal in line with the axis of the joints. The wheels are guaranteed to develop an efficiency of 80 per cent of the theoretical energy in the water delivered to each wheel at full rated load, 75 per cent at three-quarters load and 70 per cent at half load. In tests made, the efficiency obtained at full load was 83 per cent. The main generating units are spaced 24 ft. 4 ins. apart, center to center.

At the down-stream end of the engine room are located two exciter units, foundations being provided for a third. Each unit consists of a 40-kw, 125-volt generator coupled to a 60-hp Pelton wheel; coupled at the other end of the Pelton wheel is a 60-hp induction motor, the object of the latter being to act as a speed regulator for the exciter, the position of the adjustable needles in the deflecting nozzles being fixed to take care of the normal load on the exciters.

At the rear of the exciter units is the switchboard gallery, the floor of which is 8 ft. above the engine-room floor level. The center of the gallery will be the ultimate center of the power station when the plant is duplicated. On the switchboard gallery is located the main controlling switchboard, consisting of four generator panels, two exciter panels, one motor panel, one transformer panel, one regulating switch panel, and two line panels. In front of the gallery is a table switchboard inclined to a slight angle, on which are distributed the switches for controlling the oil switches and water-wheel governors. These switches are provided with red and green lamps, which indicate whether the oil switches are open or closed and the connections are engraved on the marble so that the attendant can see at a glance which line or bank of transformers he is operating.

In the low-tension bus-bar corridor are located the 2400-volt bus bars which lead from the hand-operated oil switches and bus bars on the switchboard to the remote control oil switches controlling the low-tension side of the transformers.

In the transformer room there are 7 G. E. transformers, each having a rated capacity of 350 kilowatts and arranged in two banks of three each, with the seventh as a spare. The transformer ratio is 2400 to 20,000, and they are connected in "delta" on the low-tension side and in "star" on the high-tension side, with neutral earthed giving a potential of 34,700 volts between phases. The primary full-load current is 146 amperes and the secondary full-load current 17.5 amperes. The transformers are oil insulated, water cooled, and each tank contains 350 gallons of oil. They are guaranteed not to exceed a temperature rise of 35 deg. C., after 24 hours' run at full load and 50 deg. C., after two hours' run at 25 per cent overload, and the tests prove that these guarantees were fully conservative. The efficiency of the transformers at full load is 97 per cent, the regulation with non-inductive load 1.4 per cent, and at 90 per cent power-factor 2.8 per cent. Each transformer is 11 ft. high by 4 ft. by 3 ft., weighing 5.7 tons, and is connected to a system of oil piping by means of which the oil can be drained from the transformer to a well, and a small electrically-driven rotary pump lifts the oil to tanks overhead, from where it gravitates back to the transformers; the transformers are also connected to a circulating water supply. Each transformer is mounted on wheels and can be shifted off its bed on to a car and wheeled into the engine room so that it can be taken apart with the aid of the overhead traveling crane.

There are several small transformers in the power station for various purposes. Three 40-kw transformers are connected to motor and lamp circuits, the potential being regulated by taps connecting to the dial switches on switchboard. Series transformers are connected in transmission lines for operating the overload relays and line ammeters.

In the high-tension bus-bar corridor at rear of transformer room are the bus-bars connecting the oil switches on the high-tension side of the transformers to the oil switches controlling the line bus bars. This bus-bar corridor is constructed on the cellular principle with concrete partitions, and all high-tension wires are kept a minimum distance of 12 in. from earth.

In the oil switch room are located the remote control oil switches, which are of two types: There are four of the Westinghouse solenoid operated type which connect 2400 volt bus bars to the low-tension side of the transformers, four G. E. motor-operated type which connect the high-tension side of the transformers to the bus bars, four of the Westinghouse solenoid type which connect the high-tension bus bars to the 35,000 volt line bus bars and two G. E. motor-operated type which control the two transmission lines. The switch compartments are built up with concrete walls separating each chamber, and the doors are hung from the top, so that they are free to fly outwards in the event of explosion in the oil cells.

The controlling circuits for motors, solenoids and signal lamps, are taken off the 125-volt exciter circuits. The switches can be opened or closed with hand levers in case of necessity, and both types of oil switches are entirely satisfactory in operation. All oil switches throughout the system have disconnecting knife switches on either side of each leg, and the greatest care has been exercised with the station wiring, exposed bare conductors being used; the only insulated cables being those which connect the generators to the switchboard bus bars and those which connect both sides of the transformers to the disconnecting switches.

The leads from the transformers are connected to double-throw knife switches on the low-tension side and to plug switches on the high-tension side, in order to admit of the spare transformer being cut in to replace any one in service that may give out in either of the two banks. The connections to the plug switches on the high-tension side are made by means of heavily insulated flexible cable to admit of safe handling with a potential of 20,000 volts to earth. The double-throw switches and plug switches are all supported on an angle iron framework. On this framework are also carried the interconnecting bus bars between the transformers and the oil switches on both sides.

The wiring of the power station is on the duplex system throughout and admits of either generator being connected to either transmission line through either bank of transformers, independently or in parallel.

In the lightning arrester annex are six Westinghouse low-equivalent, lightning arresters, one set on each leg of the two transmission lines. Each arrester is of the standard type with a series of spark gaps in series with a resistance between them and the ground. Oil-insulated, choke coils are connected between the lightning arresters and the line oil switches to protect the transformers from damage due to surges.

The hissing of the brush discharge from the high-tension conductors is very marked and the discharge is visible at night. It was found advisable to have all insulators carefully cleaned with dry cloths at regular intervals. The operation of the plant is extremely simple, and the only electrical troubles encountered was a puncture of an insulator on one of the selector switches and a burn out in one transformer, the latter due to a heavy surge on the line.

The generators were put into operation on Nov. 3, 1906. and have been running almost continuously ever since.

Electrical energy was first sent through to Dunedin on March 19, and after the necessary preliminary experiments the whole scheme was put into permanent operation on April 7.

The power station staff consists of three engineers, three switchboard attendants and one spare man, who divide the shifts between them.

A gravitation tramway had to be constructed on the hillside to convey the material from a receiving shed at the foot of the practicable wagon road to the power station. The full truck descending hauls up the empty one. The horizontal length of the line is 1980 ft. and the total fall 720 ft. at an average grade of 36 in 100, the steepest pinch being 1 in 1.43. The tramway is constructed of birch rails laid on transverse sleepers.

The power station being at the bottom of a deep gorge does not receive any of the sun's rays for about three months of the year, and in order that the residences for the attendants should not be subjected to this condition, a site was selected on a spur about 250 ft. above the power station. It is also necessary that the houses be built away from the noise caused by the impact of the water on the impulse wheels, which is so deafen-

ing in the power station that conversation can only be held by means of a megaphone. There are three residences, Voltaire Villa, for the chief engineer and family; Ampere Cottage, for the second engineer and family; and Faraday House, for the third engineer, three switchboard attendants and the spare man. These residences are all substantially built and furnished by the Council and the barracks is provided with a billiard-room and library for the benefit of those who have to live in this isolated part of the country; there is not another residence within eight miles, and on one occasion they received no communication for nearly a fortnight, on account of snow. A description of the transmission line and sub-stations will be published in a subsequent issue.

Leakage Coefficient of Induction Motors.

By R. E. Hellmund.

In the following a formula for the "leakage coefficient"—the ratio of the total stationary reactance to the synchronous no-load reactance—of induction motors of the squirrel-cage type will be given, which, although not theoretically exact in every detail, yet takes all factors influencing the value of the leakage coefficient into consideration and produces good practical results;

l = total width of iron cores (excl. air ducts).

The following are the values which should be known for the determination of the leakage coefficient:

a_1 = number of slots per pole in the primary.
a_2 = number of slots in the secondary per pole.
Δ = length of air-gap.
λ = pole pitch in air-gap.
L_1 = the length of the conductor outside of the iron core in the stator.
L_2 = the length of the conductor outside of iron core in the rotor.
l = total width of iron cores (excl. air ducts).
AT_t = total ampere turns required for the magnetization of the motor.
AT_1 = ampere turns required for the air-gap.

Moreover, the slot dimensions as given in Fig. 1 must be known for both the primary and the secondary members. From

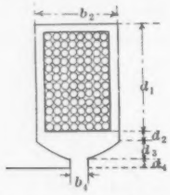


FIG. 1.—DIMENSIONS OF SLOT.

these dimensions the following factor may be determined for each member:

$$S=\frac{d_1}{3b_1}+\frac{d_2}{b_1}+\frac{2d_3}{b_1+b_4}+\frac{d_4}{b_4} \qquad (1)$$

Also the following factor may be determined:

$$\psi=\lambda-a_1(b_4\,stator-\Delta)-a_2\,(b_4\,rotor-\Delta). \qquad (2)$$

The various parts of the leakage may be expressed as follows:

$$\text{Primary zig-zag leakage}=\frac{k_1}{a_2^2} \qquad (3)$$

k_1 being a constant.

$$\text{Secondary zig-zag leakage}=\frac{k_1}{a_1^2} \qquad (4)$$

$$\text{Primary slot leakage}=\frac{3.0\times\Delta}{a_1\times\psi}S_1 \qquad (5)$$

S_1 being the factor S determined for the primary.

$$\text{Secondary slot leakage}=\frac{3.0\times\Delta}{a_2\times\psi}S_2 \qquad (6)$$

S_2 being the factor S determined for the secondary.

$$\text{Primary end-connection leakage}=c_1\frac{AT_t\times\Delta\times L_1}{AT_1\times l\times\psi} \qquad (7)$$

c_1 being a constant.

$$\text{Secondary end-connection leakage}=c_2\frac{AT_t\times\Delta\times L_2}{AT_1\times l\times\psi} \qquad (8)$$

c_2 being a constant.

The total leakage coefficient is, therefore:

$$\sigma=\frac{k_1}{a_1^2}+\frac{k_1}{a_2^2}+\frac{3.0\,\Delta}{\psi}\left(\frac{S_1}{a_1}+\frac{S_2}{a_2}\right)+\frac{AT_t\times\Delta(c_1\times L_1+c_2\times L_2)}{AT_1\times l\times\psi} \qquad (9)$$

This formula applies for motors of the squirrel-cage type with partially closed slots in both the primary and the secondary members, and for motors with open slots in one member and partially closed slots in the other member. If both members have wide open slots, the value of ψ must be determined by a somewhat different method; such motors are, however, hardly of practical importance.

FIG. 2.—PRIMARY WINDING OF CASES 1 AND 2.

The coefficient k_1 has a value of about .8 for the blocked rotor condition, while it is .47 for the running motor. For practical calculations it will be advisable to use the former value, since then the calculation of the motor based upon the coefficient will be safe for all load cases.

The coefficient c_2 may be assumed to be .50 for the customary construction of squirrel-cage rotors with a short-circuiting ring at each end of the rotor. It may be assumed to be .80 for a rotor constructed with end plates riveted directly against the iron core.

The coefficient c_1 varies largely with the style of winding used and with the arrangement of the end-connections relative to the iron of the core, to the iron of the bearing brackets, to other metal parts and to each other. It is, therefore, advisable to find this value from tests for each particular winding arrangement. This is comparatively simple, since all other factors of the leakage coefficient may be determined from the formula, while the total value of the leakage coefficient may be easily determined by tests on any motor. It has been found that c_1 has a value of from 1.00 to 1.50, and an average value of 1.25, for motors with a winding such as is shown in Fig. 2. (Case 1): It has a value of from 1.2 to 1.70, and an average value of 1.50, for the same style of winding, but wound with thinner wire and comparatively close to the bearing bracket. (Case 2): It has a value of from 1.00 to 1.50, and an average value of 1.20, for motors with such a winding as is shown in Fig. 3, the winding also being comparatively close to the bearing bracket and otherwise like case 2. (Case 3): It has a value of from .5 to 1.10, and an average value of .70, for motors with such a winding as is shown in Fig. 4. (Case 4): The values for c_1, especially those of case 4, have not been checked on very many motors, therefore they may not be very exact, but they may serve as a guide in cases where tests on a certain motor type have not been made.

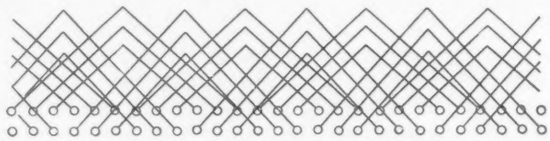


FIG. 3.—PRIMARY WINDING OF CASE 3.

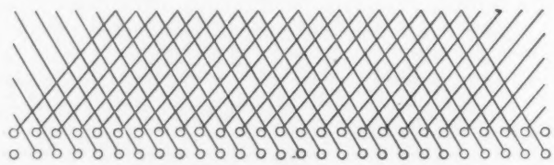


FIG. 4.—PRIMARY WINDING OF CASE 4.

In determining c_1 from tests no very exact results should be expected; it will be seen that c_1 is found from the remainder

of the test value after five other values have been subtracted. It is, therefore, evident that an inexactness of a comparatively small percentage in the test will cause a comparatively large error in the remainder, and, therefore, in c_1.

The value L_1 also varies largely with the style of winding, and it can be determined only from practice; for full pitch windings it has been found that L_1 varies from 1.6λ to 2.3λ. The value L_2 may be assumed to be λ plus twice the distance of the short-circuiting rings from the iron core. Where air ducts are used their total width should be added to L_1 and L_2, respectively.

The above formula and constants have been based on full-pitch windings, and are not intended to apply to fractional-pitch windings, but the formula also fairly well applies for fractional pitch if it be assumed that L_1 has the value it would have for a full pitch winding. It is to be noted that the dimensions may be expressed in any convenient unit consistently used, that is, either the inch or the centimeter.

It is evident that the above formula for the leakage coefficient may be considerably simplified for any line of motors which is laid out fairly uniformly, because in this case some

Constructive Details of Motors.					Comparison of Test Results With Calculations.				
			Style of winding.			Formula 17		Formula 18.	
H.P.	No. of poles	Average number of slots per pole.	Primary Case No.	Secondary Case No.	Tested values of σ	Calc. value.	Error in %	Calc. value.	Error in %
2	4	9.8	4	2	.0518	.0526	+ 1.5	.0524	+ 1.2
5	6	10.1	4	1	.0645	.0685	+ 6.2	.0768	+19.0
5	6	11.3	3	1	.0500	.0539	+ 7.8	.0568	+13.6
7.5	6	11.3	3	1	.0396	.0392	− 1.0	.0468	+18.2
10.0	6	11.3	3	1	.0480	.0450	− 6.2	.0550	+14.6
2	6	6.7	3	2	.0805	.0780	− 3.1	.0899	+11.7
3	4	10.1	3	2	.0450	.0485	+ 7.8	.0569	+26.5
5	4	12.7	3	2	.0610	.0550	− 9.9	.0643	+ 5.4
2	6	6.7	2	2	.0918	.0908	− 1.1	.1016	+11.9
3	4	10.1	2	2	.0580	.0547	− 5.7	.0584	+ 7.0
4	12	5.6	2	1	.1140	.1078	− 5.4	.1185	+ 4.0
10	6	9.8	2	1	.0529	.0538	+ 1.7	.0643	+19.4
5	6	11.3	2	1	.0527	.0572	+ 8.6	.0580	+12.2
16	8	9.6	1	1	.0545	.0589	− 8.1	.0707	+29.7
15	10	12.3	1	1	.0590	.0650	+10.0	.0833	+40.0
24	10	12.3	1	1	.0570	.0551	− 3.3	.0658	+15.4
50	10	12.3	1	1	.0480	.0450	− 6.3	.0492	+ 2.5
15	6	12.8	1	1	.0499	.0560	+12.2	.0636	+27.4
35	8	15.4	1	1	.0488	.0550	+12.7	.0643	+31.8
50	8	15.4	1	1	.0450	.0463	+ 2.9	.0530	+17.8
150	8	20.0	1	1	.0424	.0401	− 5.4	.0489	+15.3

of the factors appearing in the formula are practically constant. For rough calculation one may make the following substitutions, and use the constants indicated

$$a=\frac{a_1+a_2}{2} \tag{10}$$

$$\psi=k_2\lambda \tag{11}$$

$$L_1=k_3\lambda \tag{12}$$

$$L_2=k_4\lambda \tag{13}$$

$$\frac{AT_t}{AT_1}=k_5 \tag{14}$$

In motors with moderate magnetic densities k_5 is approximately equal to 1.1.

$$\frac{3.0(S_1+S_2)}{k_2}=k_6 \tag{15}$$

$$\frac{AT_t(c_1\times L_1+c_2\times L_2)}{AT_1\times\psi}=k_7 \tag{16}$$

The following very simple formula is thus obtained for the leakage coefficient:

$$\sigma=k_1\frac{2}{a^2}+k_6\frac{\triangle}{a\times\lambda}+k_7\frac{\triangle}{l} \tag{17a}$$

or

$$\sigma=\frac{k_8}{a^2}+\triangle\left(\frac{k_6}{a\times\lambda}+\frac{k_7}{l}\right) \tag{17b}$$

where $k_8=2k_1$.

This simplified formula should give fairly good results after the values for K_8, k_6 and k_7 have been determined for a certain line of motors.

When it is more desirable to obtain a safe value, than to obtain a very exact value, it may be assumed for motor with partially closed slots in both the primary and the secondary members and for stator case 1, 2 or 3, in combination with rotor case 1 or 2.

$$\sigma=\frac{1.75}{a^2}+\triangle\left(\frac{20}{a\times\lambda}+\frac{5.5}{l}\right) \tag{18a}$$

and

$$\sigma=\frac{1.75}{a^2}+\triangle\left(\frac{20}{a\times\lambda}+\frac{4.0}{l}\right) \tag{18b}$$

for motor with partly closed slots in both members and for stator case 4, in combination with rotor case 1 or 2.

With these coefficients, the formula will, as a rule, give values which are too large.

All of the values given above for k_1, and the coefficients in formula 2 refer to three-phase motors. For two-phase motors they may be slightly different, since the end-connection leakage flux interlinking with all the phases is different in two-phase motors from what it is in three-phase motors. The difference will be comparatively small in case of the primary windings of case 1 and 2, while it will be larger for primary windings of case 3 and 4.

In the accompanying table a number of tested values for the leakage is given in comparison with the values derived from the formulas; for formula 17, use has been made of the average values given for k_1. In each case the length of the air-gap has been determined from the observed magnetizing current.

It will be seen that the errors of formula 17 are comparatively small, those of formula 18 are rather large in some cases, as is to be expected; it will be safe, however, to use formula 18, since all of the errors are on the safe side.

Abnormal Primary Current and Secondary Voltage on Placing a Transformer in Circuit.

By J. Murray Weed.

In the following there is offered an explanation of the results obtained by Messrs. Jensen and Andree, as recorded by Mr. Jensen in his article in the Electrical World for Sept. 14, on "Abnormal Primary Current and Secondary Voltage on Placing a Transformer in Circuit."

Assuming a constant alternating e. m. f. applied to the terminals of a transformer, with open secondary, the total counter e. m. f., which must be equal and opposite to the applied e. m. f., is the resultant of components due to the rate of change of magnetism in the iron, to the resistance of the winding and to the reactance attributable to magnetic lines at least part of whose circuit is outside the iron. The last two of these counter e. m. f.'s, which do not appear in the secondary circuit—not strictly true of the latter—but constitute the e. m. f. drop in the primary windings of the transformer, become negligible in normal operation, with open secondary. In this case the counter e. m. f. due to the magnetism in the iron is practically equal and opposite to the applied e. m. f., and the relative phase position and magnitude of applied e. m. f., magnetism and magnetizing current, may be represented somewhat as in Fig. 1. The current is in time-phase with the magnetism, with each instantaneous value depending upon the instantaneous value of magnetism and the corresponding reluctance of the iron. The component of the exciting current which is in time-phase with the applied e. m. f., supplying the losses, is not shown.

It should be noted, in Fig. 1, that the maximum point of the magnetic cycle, and of the magnetizing component of the exciting current, occur at the instant when the e. m. f. is passing through zero, and vice versa. Considering now the conditions from the instant when the e. m. f. passes through zero, it is seen that the magnetism passes through a half circle, beginning with its maximum value and ending with the maximum value in the reverse direction. The total number of lines cutting the trans-

former winding in the same sense, during the half cycle of e. m. f. beginning with a zero value, is, therefore, twice the maximum total magnetism in the core, since the total magnetism cuts out of the coil in one direction and into it again in the opposite direction.

Suppose, now, that the transformer is inactive with no residual magnetism in the core, and that the e. m. f. is suddenly applied at the instant when it is passing through zero.

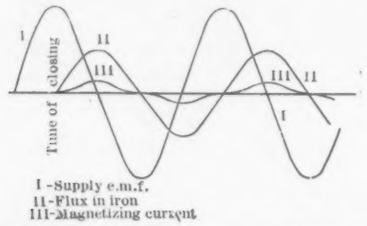


FIG. 1.—RESULTS OF CLOSING CIRCUIT AT MAXIMUM E. M. F.

If the counter e. m. f.'s due to resistance and to the flux in air are negligible here (this assumption will be made at first in this and the following cases), the cycle of magnetism in the iron will be the same as before, when the transformer was in normal operation, except that instead of starting from a maximum value and going to a maximum value in the opposite direction, it will start from zero, and must, therefore, pass to twice its normal maximum value. (See Fig. 2.) It is evident that even though the normal flux density in the core is fairly low, it will be high at double normal density, and the reluctance at this point will be high. The magnetizing current will, under these conditions, be large, having passed from zero, when the e. m. f. was first applied, to a large value at the end of the first half cycle. During the second half cycle both the magnetism and the magnetizing current will evidently return to their zero values, having passed through a complete cycle of change without reversing in direction. The magnetizing current is thus a pulsating current, with a maximum value which will be very large if the normal flux density in the core is high, since the maximum density reached may be far beyond saturation for the iron.

If a residual magnetism exists in the core and the e. m. f. is applied at the instant when it is passing through zero, as above described, the direction of the residual magnetism being

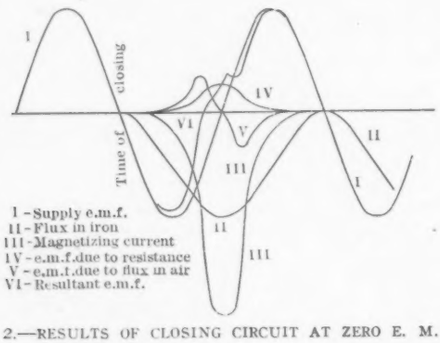


FIG. 2.—RESULTS OF CLOSING CIRCUIT AT ZERO E. M. F.

the same as that which will be produced, the maximum flux density reached will evidently be just that much greater than it otherwise would have been, so that the magnetizing current in this conjunction of circumstances may become exceedingly great. On the other hand, a residual magnetism in the reverse sense would make a corresponding reduction in the maximum value which will be reached by the flux and by the magnetizing current. During the second half cycle, the magnetism will in both cases return to the residual value at which it started, so that the cycle of change may be alternating, but with greater maximum value in one direction than in the other, or it may exist in the same direction throughout the cycle, and not reach zero value at all.

If the e. m. f. be suddenly applied to the transformer, at the instant of maximum value, instead of at its zero value as above, with no residual magnetism in the core, both the flux and the magnetizing current will have their normal value at the time of closing, and should enter their normal cycle without disturbance. Likewise, with the e. m. f. applied at any other point in the cycle, if there is a residual magnetism in the core of such a value as would be normal at the instant of closing, both the magnetism and the magnetizing current should follow their normal cycle, with only a slight disturbance, the latter being attributable to the fact that the magnetizing current must increase from zero at the first instant.

It is evident that any other conjunction of conditions as to residual magnetism and time of closing than those mentioned in the last paragraph will result in an abnormal cycle of magnetic change and magnetizing current at the start. Moreover, this abnormal state would continue indefinitely if the counter e. m. f. due to the flux in the iron were the only one to be considered, as assumed above. It is necessary, however, to consider the counter e. m. f.'s due to resistance and to the flux in air, which, though negligible when the current is small, as when the transformer is in normal operation with open secondary, yet must be considered when the magnetizing current is abnormally great, as in some of the above conditions of starting.

The instantaneous value of the counter e. m. f. due to the flux in air is directly proportional to the instantaneous rate of change in the value of the current, and in such a direction as to oppose that change. It depends upon the shape and amplitude of the current wave, but is independent of its position relative to the zero line. Thus, whether the current be an alternating one, or a pulsating one, the e. m. f. due to the flux in air will be an alternating e. m. f. It will differ in phase, however, from the e. m. f. due to the flux in iron by the same amount that the exciting current differs in phase from the magnetizing component. It will, therefore, change the phase relation and reduce the extreme unbalance which otherwise would exist at the start in the cycle of flux in iron and of magnetizing current, but it will not tend to change this cycle from that at first established.

Consider now the counter e. m. f. due to resistance. In the case where flux and magnetizing current exist in the same direction throughout the cycle, this e. m. f. will also exist in the same direction throughout the cycle. It will oppose the impressed e. m. f. during the half cycle in which the flux is increasing, but augment it during the half cycle in which the flux is decreasing. The total change in flux necessary to maintain a zero resultant between applied and counter e. m. f.'s is, therefore, considerably greater in one sense than in the other, the result being an approach toward normal conditions. The *IR* drop due to an unbalanced cycle of magnetizing current is thus the main factor in bringing about normal conditions in the cycle of flux and of magnetizing current.

The curves of Fig. 2 are a first approximation to what, in view of the above considerations, will occur when an e. m. f. is applied at the instant when it is passing through zero. The shape and phase relation of the curve for "Flux in Iron" is based upon the assumption that it must generate an e. m. f. which is equal and opposite to the applied e. m. f. The maximum flux density is assumed to be much above saturation for the iron, so that the magnetizing current is very large. The resulting e. m. f.'s due to resistance, and to flux in air, when combined with the applied e. m. f., produce a "resultant e. m. f." which, instead of the applied e. m. f., must actually be neutralized by the e. m. f. due to flux in iron. The result is that the curve of flux in iron, and therefore all the other curves indicated in Fig. 2, except the applied e. m. f., will be quite different from those actually shown. The loss element of the exciting current is neglected in the curves for the sake of simplicity.

The foregoing considerations explain the results recorded by Mr. Jensen as to the behavior of the primary current upon connecting a transformer in circuit, as shown in Fig. 5 of his

article, but do not explain why the secondary e. m. f. should behave as shown in Figs. 1, 2, 3 and 4. In fact, there appears to be no way of accounting for a secondary e. m. f. higher than normal except by a rise in the primary e. m. f. The writer has been unable to detect a rise of secondary e. m. f. in the oscillograms given, although his Fig. 8 shows a considerable rise in the primary e. m. f.

Beyond any doubt the results obtained by Mr. Jensen are very mild indeed as compared with what would have occurred if the tests had been made at the full rated voltage of the transformer. When the normal flux density is high, the magnetizing current required to produce a given percentage increase in this density will be much larger than if the normal density be lower.

When it is considered that many of the large transformers built at the present time are designed for a high normal flux density, and that a considerable reduction in the density would necessitate an increase in their cost, it would seem that some means of bringing these transformers into circuit without the instantaneous application of full voltage is not only desirable, but important. The use of a choke coil or inductance, as suggested by Mr. Jensen would, as demonstrated by him, be advantageous, but where the normal density in the transformer is high, this scheme might not suffice for decreasing the current rush to a satisfactory value. There could be used for this purpose a small auxiliary regulating transformer, of sufficient rating to supply exciting current to the main transformer while raising the e. m. f. on the low tension side, by steps, from a small value up to normal before connecting it to the circuit.

Characteristics of the Solenoid.

BY CHARLES R. UNDERHILL.

In order to calculate accurately the pull due to a plunger-electromagnet or an iron-clad solenoid at various points throughout the entire range, it is important to know the solenoid effect, or the pull due to the magnetizing force of the winding and the magnetic induction in the core or plunger for various relative positions. The pull due to a plunger-electromagnet may then be found for all points within the range of the magnet by adding the pulls due to the induction between the plunger and the stop, to the pulls due to the solenoid effect.

Data for determining the maximum pulls of solenoids of various dimensions and magnetizing forces were given in a previous

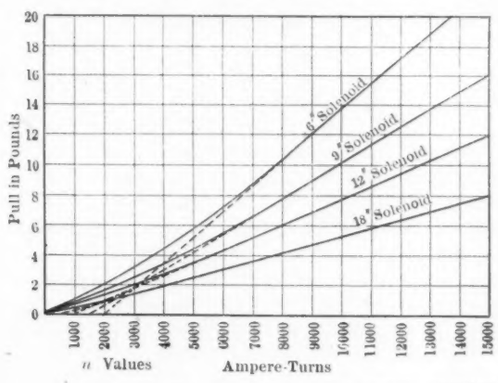


FIG. 1.—RATIO OF AMPERE-TURNS TO PULL WITH PLUNGER ONE SQUARE INCH IN CROSS-SECTION.

article,* and from it Fig. 1 is reproduced herewith in a somewhat modified form, as showing these maximum pulls with variable ampere-turns and 1 sq. in. of plunger.

In Fig. 2 are shown the curves of several solenoids of various lengths, each winding being 3⅛ ins. diameter. The plunger used in the test was 36 ins. long and 1⅛ ins. diameter, making the cross-sectional area 1 sq. in. The magnetizing force in this test was 15,000 ampere-turns for each coil, which caused the iron plunger to be thoroughly saturated, as reference to Fig. 1 will show. This would make the ampere-turns per inch of length in the various solenoids as follows: 6-in., 2500; 9-in., 1560; 12-in., 1250, and 18-in., 830.

By grouping the curves in Fig. 2 on a common plane, so as to make the ampere-turns per unit length the same in all cases

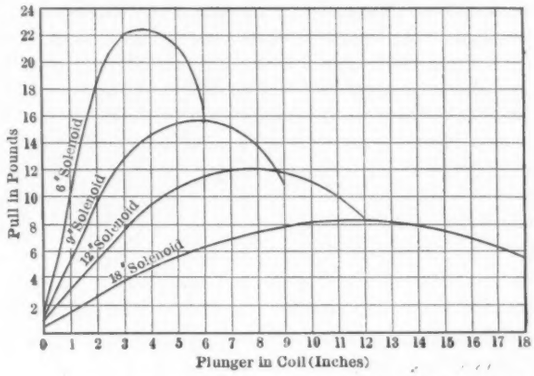


FIG. 2.—TEST OF SOLENOIDS WITH 15,000 AMPERE-TURNS.

(see Fig. 3), we find that the curves are similar, with the exception that the peaks of the curves are proportionately higher for the longer solenoids. If, however, the pulls throughout the entire range of each curve in Fig. 3 are compared with the maximum pull for that solenoid, the curves are found to be

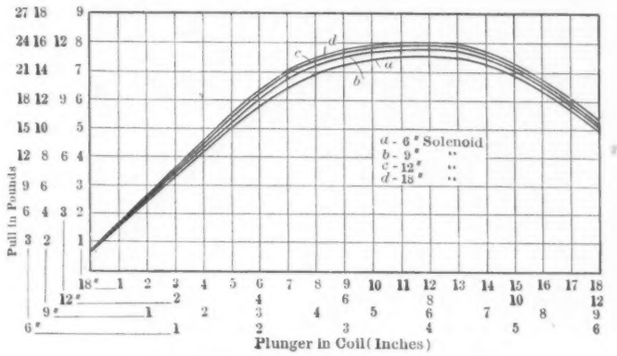


FIG. 3.—COMPARISON OF SOLENOID CURVES.

practically similar in all cases cited. This common curve is illustrated in Fig. 4.

It therefore remains to determine the locus of this curve, which is partly sinusoidal, and the equation

$$y = \sin 0.77x \qquad (1)$$

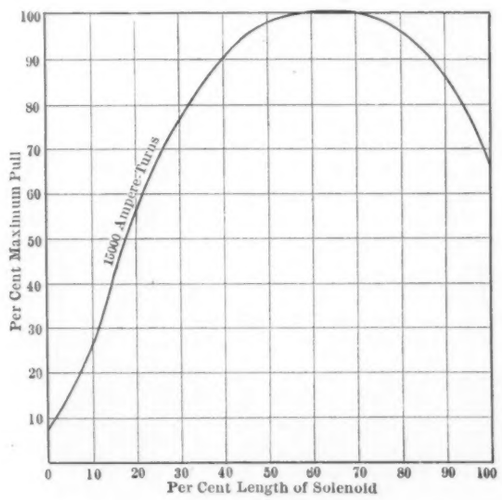


FIG. 4.—AVERAGE OF CURVES.

satisfies this condition for practical purposes, as reference to Fig. 5 will show. In this case the length of the solenoid is compared with 180 deg. In order to make a direct comparison

*"Calculation of Pull Due to Solenoids," *Electrical World and Engineer*, May 13, 1905.

the 9-in. solenoid is assumed in Fig. 5, although this curve is common to all the other solenoids as in Fig. 4.

While the solenoid pull curve in Fig. 5 is slightly higher than the $y = sin\ 0.77x$ curve from 25 deg. to 120 deg., it must be understood that the percentage of maximum pull throughout the first half of the solenoid is greater for higher than for lower magnetizing forces, owing to the fact that the plunger is

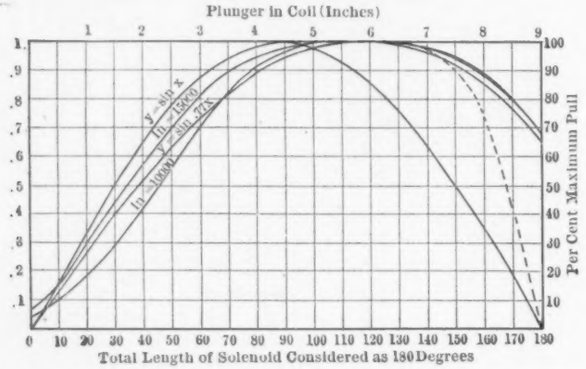

Plunger in Coil (Inches)
Per Cent Maximum Pull
Total Length of Solenoid Considered as 180 Degrees
y = sin x
In = 15000
y = sin .77x
In = 10000

FIG. 5.—AVERAGE SOLENOID CURVE COMPARED WITH SINUSOID.

more quickly saturated under the former condition, thereby increasing the pull—or, to be exact, the percentage of maximum pull; and since this curve represents the pull due to 15,000 ampere-turns, the percentage maximum pull would be somewhat lower with a magnetizing force just sufficient to saturate the plunger at the position of maximum pull, and therefore the curve $y = sin\ 0.77x$ represents a good average, as the curves beyond the point of maximum pull do not vary appreciably as the magnetizing force increases, after the plunger is saturated.

This effect is illustrated in Fig. 6, which is the result of a test of the 12-in. solenoid; the maximum pull being the same as indicated in Fig. 1. An inspection of Fig. 6 also shows that the range of the solenoid is much greater with high than with low magnetizing forces.

Again referring to Fig. 5, the dotted curve represents the effect of using a plunger of the same length as the solenoid.

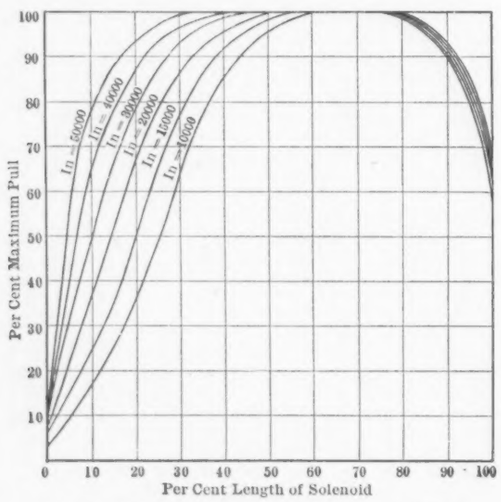


FIG. 6.—EFFECT OF INCREASING AMPERE-TURNS.

Referring to Fig. 1, it is evident that after the plunger is saturated each curve will be practically a straight line, and hence to calculate the ampere-turns for any solenoid from the data given, necessary to produce any other maximum pull P (pounds), the formula will be

$$IN = \frac{IN_c P - n\,(P - P_c)}{P_c} \qquad (2)$$

Where IN_c and P_c represent the ampere-turns and pull in pounds respectively (and above saturation) per 1 sq. in. of cross-section of plunger, upon which the calculation is based. The values of n are indicated in Fig. 1, where the dotted continuations of the straight portions of the curves touch the axis of abscissas.

Similarly to determine the maximum pull under these conditions, (2) may be written

$$P = \frac{P_c\,(IN - n)}{IN_c - n} \qquad (3)$$

If we let $$S = \frac{IN_c - n}{P_c} \qquad (4)$$

(3) becomes $$P = \frac{IN - n}{S} \qquad (5)$$

and $$IN = PS + n \qquad (6)$$

The values of n, P_c and S are expressed with a fair degree of accuracy by the formulae

$n = \frac{12{,}000}{L}$ (7), $P_c = \frac{90}{L}$ (8) and $S = 98L$ (9) for solenoids within the limits of those discussed, and in which L is the length of the winding in inches.

Substituting the values of (7) and (9) in (5),

$$P = \frac{IN - \frac{12{,}000}{L}}{98L} \qquad (10)$$

and $$IN = 98LP + \frac{12{,}000}{L} \qquad (11)$$

In everything thus far a plunger area (cross-sectional) of 1 sq. in. is assumed. In order to determine the cross-sectional

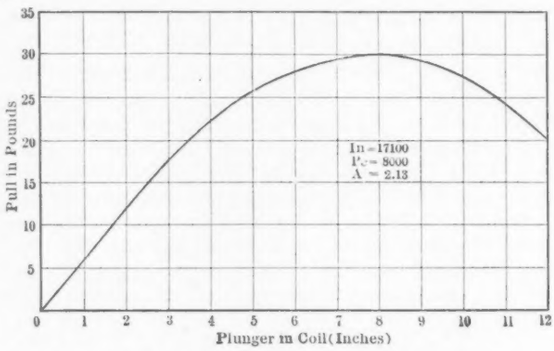


FIG. 7.—CALCULATED CURVE OF 12-IN. SOLENOID.

area A of a plunger to give the proper value for IN_c with any total ampere-turns IN_t use may be made of the formula

$$A = \sqrt{\frac{IN_t}{IN_c}} \qquad (12)$$

Values assumed for IN_c should always be taken above the saturation point, *i. e.*, on the straight portions of the curves in Fig. 1.

Applying this mode of calculation to a specific case, assume a solenoid 12 ins. long to have a maximum pull of 30 lbs.

Using (11) and assuming $IN_c = 8000$,

$$IN_t = 98LP + \frac{12{,}000}{L} = 98 \times 12 \times 30 + \frac{12{,}000}{12}$$
$$= 35{,}280 + 1000 = 36{,}280.$$

Therefore by (12), $A = \sqrt{\frac{36{,}280}{8000}} = 2.13$ sq. ins.,

and instead of using 36,280 ampere-turns and a plunger 1 sq. in. in cross-section, only $2.13 \times 8000 = 17{,}100$ ampere-turns will be required for the same pull, but with a plunger 2.13 sq. ins. in cross-section. This may be expressed as follows:

$$IN = IN_c A \qquad (13)$$

Now, from these data a curve may be plotted showing the approximate pull at all points throughout the range of the solenoid. It will be recalled that the ratio of the actual

pull to the maximum (y) is equal to $\sin 0.77x$; and if we let l represent the distance in inches the plunger is in the coil, and compare the linear ratios with those represented by degrees, we have $x = \frac{180l}{L}$ (14)

Representing the pull by p, the ratio of actual to maximum pull is $\frac{p}{P} = \sin \frac{.77 \times 180l}{L}$, whence $p = P \sin \frac{138.6l}{L}$ (15)

Fig. 7 is plotted from (15), the values of P and L being 30 and 12, respectively, as in the example worked out.

Rubber Insulation for Conductors—I.

By Fred J. Hall.

INTRODUCTORY.

This article is limited to the consideration of rubber as insulation for electrical conductors. No attempt is made to treat the subject exhaustively; its object is to present a few general facts regarding rubber, and some special information, based on practical experience, as to its use for the insulation of electric wires and cables.

Theory and practice cannot always be made to harmonize. Knowledge acquired solely from text-books, laboratory experiments and office work, however, valuable, must be supplemented by practical experience before any theory can be evolved that will hold good when applied to the production of a manufactured article in commercial quantities. While this fact is self-evident, its neglect is the most prolific source of trouble to both the purchaser and the manufacturer of rubber insulated conductors. The writer will endeavor to treat the subject unprejudicedly. He realizes that want of practical experience in the manufacture of insulated wires and cables would naturally lead to impractical conclusions; also that the purchaser is entitled to the protection afforded by such test as will best prove the practical efficacy and life of the insulation.

PARA RUBBER.

A great deal of misconception exists regarding para rubber. The name is a geographical one, and it is applied to rubber coming from widely different localities, principally in Brazil, Bolivia and Peru. There are differences in the qualities of paras, depending not so much on locality as on methods of gathering and coagulation. For commercial purposes these have been divided into three grades:

Fine.—The clean, thoroughly smoked or cured biscuits.

Medium.—In the center of which there is more or less moisture or milk, due to imperfect curing.

Coarse.—The residue scraped from the collecting vessels.

As the growth of industries requiring the use of rubber has of late years been enormous, the price of para has steadily advanced. The supply was inadequate to the demand, and the use of rubbers other than para became absolutely necessary. Various grades of rubber are produced in all parts of the tropical world, Africa furnishing the larger part and the better qualities. The methods of gathering these rubbers were at first crude. They were dirty and improperly cured. These defects have been largely overcome, and to-day rubber compounds can be made, containing no para, that will have as long a life and give as good practical results as an all-para compound. Were all manufacturers of rubber goods to confine themselves to the use of para, prices would advance by leaps and bounds. The rubber insulating industry, and others dependent upon it, would be paralyzed. These are cold facts to which the purchaser can no longer remain oblivious.

PROPERTIES OF RUBBER.

The most important properties of rubber, considered only from the standpoint of insulation, may be grouped under the following heads: 1. Non-hydroscopic; 2, dielectric; 3, mechanical strength; 4, elasticity.

All these properties except the non-hydroscopic property are materially affected by the process of manufacture, and each one is developed more or less at the expense of the others. This will be shown later on.

COMPOUNDS.

In selecting a rubber compound for insulation the manufacturer carefully considers the following points: First, conditions of service; second, what quality will best meet these conditions with an ample factor of safety and the least cost to the purchaser; third, how, in the process of manufacture, can the most essential qualities of the rubber be developed, so that the compound in its final state will have the greatest practical efficacy.

As a rule, the manufacturer has no difficulty in determining the quality of the compound and the method of treating it so as to produce the best results at the lowest price. The stumbling block appears when he tries to harmonize his ideas, based on practical experience, with the theories of the purchaser as expressed in the specifications.

As a matter of fact, the purchaser has no real interest in the composition of the rubber compound, nor in the manufacturing methods of handling it. His sole interest is to secure an insulation possessing high practical efficiency for the conditions of service. In other words, to purchase cables that will work for a long time and give no trouble. Many a purchaser has become convinced that this result can only be obtained by the use of fine para rubber, and draws specifications in a way that he believes will preclude the use of anything but fine para. In doing so he often subjects himself to useless expense, and forces the manufacturer to produce an article which he knows is higher in price and no more effective for the conditions of service—perhaps, less so—than could be produced if the manufacturer was allowed to exercise some discretion in the matter.

Let us now consider the various tests by which the purchaser endeavors to secure what he considers the best insulation. When a specific compound is called for, it is usually one containing 30 per cent para, and in considering the following tests the writer has such a compound in mind.

ACETONE TEST.

Para being the first rubber to become well known, it was made the standard. Its chemical and physical properties were carefully determined, and the insulating value of other rubbers was erroneously fixed by the extent to which they were shown to possess these identical properties. In all rubbers there is a percentage of oily or resinous matter soluble in heated acetone. The percentage of this resinous or extractive matter varies widely in different brands of rubber, *"nor is the quantity constant in the same brand."* (Weber, "Chemistry of Rubber," pages 3 and 4). Unvulcanized fine para rubber varies in the amount of its extractive matter from 1 per cent to 2 per cent. It has been assumed that unvulcanized rubber containing a higher percentage of extractive matter than that determined for para are of less value as insulators; an erroneous assumption.

Weber, page 4, says, *"The presence of these resins in crude rubber does not appear to affect its stability in an appreciable degree."* In the same paragraph he explains that the presence of the extractive matter *does* affect vulcanization, when it exists in larger quantities than is generally found in fine para. In such cases, more sulphur as well as an increase in the factors of time and heat is necessary to prevent the under-vulcanization of the compound in which form it is *"highly perishable."* It is evident, therefore, that a rubber containing a higher percentage of extractive matter than para may be quite as effective an insulator, *if properly vulcanized.*

It is often assumed that the extractive matter in rubber is highly volatile, and that when this extractive matter disappears the rubber is left lifeless and brittle. As a matter of fact, the extractive matter is not volatile; the hardening of the rubber is due to the drying out of moisture and to oxidation—principally the latter. Dr. Werner Esch, of Hamburg, in a pamphlet entitled "Observations Concerning the Best Method of Vulcanizing India Rubber," makes a statement bearing directly on this subject. He says, *"It is erroneous to believe that the best rubber articles are made from pure caoutchouc"* (rub-

ber), and calls attention to the increase *"as to elasticity and resistance to tearing asunder"* in inner tubes for pneumatic tires when 0.5 per cent of pitch is added to the rubber. Now there is probably no article into which rubber enters where it is more important to increase the strength of the rubber and prevent hardening than inner tubes, and it has been proved that this is best done by the addition of an ingredient possessing a high percentage of extractive matter of the same general character as that obtained from the rubber. Furthermore, if the hardening of a rubber compound by age was due to the dissipation of the extractive matter, less of it would be found in an old and brittle compound than in the same when new and elastic. Such, however, is not the case; in many instances it will be found that aging has increased the extractive matter, especially if it has taken place under conditions when the temperature was at times above normal.

In accepting 1 per cent to 2 per cent as the standard for extractive matter in fine unvulcanized para, it should be borne in mind that this result was obtained from specially selected samples, and that the tests were made by eminent chemists, who brought to their task unusual skill and experience. The manufacturer cannot purchase rubber in commercial quantities that will average in fineness selected samples for laboratory use, and it is not likely that the conditions under which the acetone test is generally made by a purchaser or his employee will be productive of as accurate results as when made by a Weber or a Henriques. The writer knows of a representative of a large purchaser of rubber insulated conductors who makes acetone tests upon which the acceptance or rejection of thousands of dollars' worth of goods may depend, who admitted he had never seen a Weber improved soxhlet, and that he determined the amount of extractive matter by the discoloration of the acetone. The worthlessness of such tests and the injustice that may be done to a manufacturer by them are obvious.

Vulcanized rubber always shows an increase in extractive matter over the pure unvulcanized gum. This is due to chemical changes, the exact nature of which is not known, though they are probably caused by the heat necessary for mixing and vulcanizing. In all vegetable matter heat produces chemical changes—decomposition or oxidation—the extent of these changes depending upon the degree of heat and time of exposure to it.

Sulphur is also soluble in acetone, and the free sulphur will appear in the acetone extract. As this free sulphur may vary from 2 per cent to a fraction of 1 per cent, it is obvious that when it is included in the extractive matter, widely different results may be obtained from compounds in which nothing but fine para is used. It is safe to say that a compound giving approximately 6 per cent of extractive matter and free sulphur has little or no organic matter other than fine para; also that a smaller percentage of extractive matter would be no proof that a better quality of rubber was used. The removal of the free sulphur from the extractive matter is a somewhat complicated process and is not always done, though it should be if strictly accurate results are desired. The question as to what percentage of free sulphur should exist in a rubber insulating compound is treated under a separate heading.

The addition of organic matter other than para has been shown to be highly desirable, and when this is done an increase in extractive matter takes place. The point to be determined in fixing the percentage allowable under the acetone test is not the minimum amount obtainable from a pure para compound, but the maximum amount that can safely be allowed while precluding the too free use of less expensive organic matter. The writer would consider that if other tests were satisfactory, there would be no danger of over-adulteration in a compound showing 8 per cent of extractive matter, including free sulphur.

The writer's attention was recently called to the fact that the wax used for weatherproofing the braid increased the percentage of extractive matter in the rubber compound. The inference was that the rubber absorbed a small quantity of the oily and resinous matter always largely present in all cable waxes and weatherproofing compounds.

In order to get reliable data on this matter the following experiment was made:

Four sample lengths of No. 14 B & S were insulated with four grades of rubber compound and vulcanized. An acetone test was made of the compounds on these samples before braiding and waxing. Samples were then braided and waxed. The braid carefully removed, the rubber wiped with a clean rag to remove any small particles of wax that might cling to the surface, and the acetone test was repeated.

The following table shows the results of this experiment. The column headed "After" gives the percentage of extractive matter after braiding and waxing. Column headed "Before" gives percentage of extractive matter before braiding and waxing. The difference shows the increase in extractive matter apparently due to the weatherproofing of the braid.

Sample.	Per Cent After.	Per Cent Before.	Per Cent Difference.
1	5.91	5.43	.48
2	5.72	5.28	.44
3	4.33	3.97	.36
4	3.50	2.91	.59

The above includes free sulphur. While this increase would not lessen in the slightest degree the dielectric value of the rubber compound, the fact that it takes place should be borne in mind. In some case—especially if the surface wax is not carefully removed—this increase might be sufficient to make the result of an acetone test come just outside the specification requirements.

ASH TEST.

This is simply the burning up of the organic matter in a compound, leaving as ash the inorganic or mineral matter. Perfect combustion and accurate weighing are necessary in making this test. The writer has seen variations of 6 per cent in the ash obtained from the same compound, due entirely to inaccuracies in weighing and carelessness in burning. The amount of rubber in a compound varies with the conditions to be met; it is seldom less than 30 per cent nor more than 40 per cent. The percentage of ash required should be made to cover such variations. A minimum of approximately 56 per cent, and a maximum of approximately 68 per cent, would accomplish this. The sample to be burned should be cut into very small pieces, so as to have as large a surface exposed to air as possible. This helps materially to produce perfect combustion.

If a purchaser is not equipped to properly make an acetone and ash test, there are laboratories in all our large cities where he can have these tests made accurately and at a small cost.

In a subsequent article, the stretch test, the tensile strength test, the tests for the insulation resistance, temperature coefficient, etc., will be discussed, and suggestions made as to specifications.

New Telephone Patents.

PARTY-LINE SERVICE METERS.

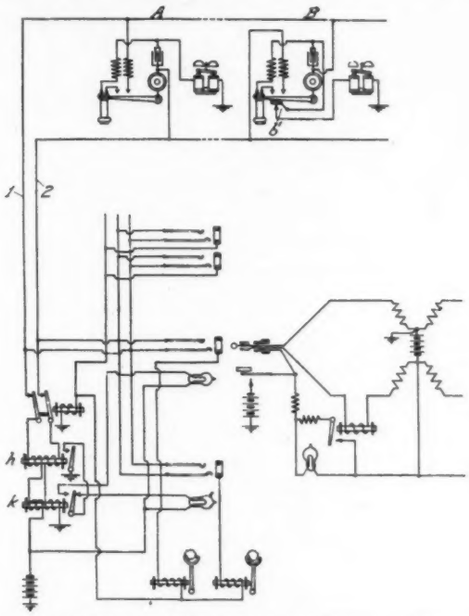
Where telephone service is sold upon the message basis there must always be some way of recording each sale, i. e., message. For a long time regular tickets were written by the operator for each call, but of recent years an effort has been made to do this work mechanically. The successful system has provided a key associated with each pair of cords, which key so manipulates the electrical circuits as to operate a meter associated with the line into which the cord happens to be plugged.

This system will, however, not work where there is more than one station connected to the line unless there be some added means of differentiating between the different stations. Mr. J. L. McQuarrie, of Chicago, has obtained patents for two different applications of this system to party lines, his patents being assigned to the Western Electric Company.

In one arrangement, a meter control relay is included in series with the line relay. This relay is a limit relay, adjusted to fail on certain current values to which the line relay will respond. One of the stations on the line is wired, normally, so that upon a call being originated, the normal current flows and the control relay responds with the line relay, and the proper

meter becomes associated with the line. At the second station, a high resistance polarized relay is included in the normal transmitter circuit, and while the line relay operates, the control relay fails and leaves the second station meter connected in. When the line is plugged into, a reversed current is sent out upon the line and the result is an operation of the station polarized relay. The contact of it thereupon shunts out of circuit such a large part of its winding that, while it remains operated, the effect upon transmission is negligible.

In the second arrangement two answering jacks are used, the one for each station. One meter and one line signal is associated with each, as shown in Fig. 1. The control of line



MC QUARRIE SERVICE METER FOR PARTY LINES.

signals lies in the relay *k*, which is differentially wound, together with the contact *b* at station *B*. By tracing the circuits, considering the hook elevated at station *A*, it will be seen that at that station the bell coils are in parallel with a circuit composed of line *I*, the two induction coil windings and the receiver, and one winding of each of the two line relays. It will thus be seen that the current in the two windings of the differential relay are not the same and this relay operates. For station *B*, the bell circuit is opened, and its unbalancing effect is lost and the control relay fails.

RECEIVER SUPPORT.

A receiver support, adaptable to either desk stands or wall sets, forms the invention of R. Higgins, of Canfield, Ohio. In both cases the receiver is supported upon a bar. This bar carries a pin so adjusted that when the receiver is pushed back out of the way the pin engages and depresses the hook switch.

TESTING PLUGS FOR PROTECTORS.

Frank B. Cook, of Chicago, has patented two different test plugs for two different types of his self-soldering heat coils. These plugs are adapted to be inserted in the arrester springs and to register with them and the heat coil contacts, so that at will an abnormal current may be put upon the coil to operate it. The current source is then disconnected and the plug withdrawn, which acts leave the protective apparatus automatically reset for further use.

LETTER TO THE EDITORS.

Color of Illuminants.

To the Editors of Electrical World:

SIRS:—To the onlooker, the present war—waged principally by salesmen—over the color of illuminants is not without its amusing features. A prospective customer for ilumination is one day solemnly assured that the common enclosed arc gives daylight color values; on another day the same quality is claimed as distinctive of the Nernst glower, and then along comes one of our gas friends with claims as to the absolutely white light given by a specially treated mantle. The incandescent-lamp salesman, knowing that his product is too yellow to carry any claims whatever to being a rival to daylight, asks why people want a white light anyway, and so the controversy goes on. The amusing part of the whole situation, both from the practical commercial and the scientific standpoint, is that every day of our lives we work under such a great variety of colors of light, both natural and artificial, that the task of prescribing the ideal color which artificial iluminants should have is practically hopeless. If daylight itself, as we receive it, were perfectly constant as regards its color, it might be reasonable to set it up as the standard toward which we should work. As a matter of fact, daylight varies considerably in color according to the amount of air, cloud and smoke the sun's rays must pass through before reaching us, so that even assuming daylight as the ideal color of light, we have a rather uncertain standard to work to. Add to this the fact that the majority of people pass their evenings contentedly under a light which is radically different from daylight, being either the yellow of the incandescent electric lamp, the kerosene flame or the open gas jet, or the greenish light of the gas-mantle burner. When one leaves aside the question of the value of different lights for color matching there seems to be little left upon which to base arguments in favor of one color of light as against another, save the general effect produced. Here again we find a lack of any definite ideal because one person will show a preference for a much whiter light than another. What seems to one to be a "soft, mellow" light is to another a "sickly yellow" light. The person who calls the common incandescent lamp a sickly luminary feels much more cheerful under a whiter light; while to his friend who likes the "soft mellow" light, a nearly white light may seem cold and lacking in cheerfulness. In the meantime the world goes on making its selections of colors of artificial illuminants mainly on the ground of economy, convenience and expediency, and probably will continue to do so for some time.

CHICAGO, ILL. JNO. L. BERTRAM.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Compounding Alternators.—J. REZELMAN AND J. PERRET.—An illustrated description of a method of compounding alternators in which the armature m. m. f. is directly made use of for obtaining a required compounding effect, without the assistance of any special compound winding or rectifier. The m. m. f. of the armature may be regarded as split up in two components, a demagnetizing and a cross-magnetizing one. The first component tends to reduce the e. m. f. of the armature, while the second produces a lateral shifting of the resultant flux. By a suitable design of the magnetic circuit it is arranged so that as the resultant flux is shifted the reluctance decreases, the flux will increase and so raise the e. m. f. of the machines. The effect of an increase in the demagnetizing ampere-turns is thus balanced by a decrease of reluctance. The compounding effect is obtained, however, only for a specific power-factor. The article is illustrated by diagrams and a numerical example is given.—Lond. *Electrician*, Nov. 1.

Connection of Transformers in Parallel.—G. Stern.—An illustrated discussion of the conditions which must be fulfilled for the successful operation of transformers in parallel, especially in the case of three-phase transformers. The latter, even if of equal ratio of transformation, cannot be connected in parallel in many cases. The condition which must be fulfilled for parallel connection, besides equal ratio of transformation, is that the windings should be so arranged that the secondary voltages have always the same phase difference against the primary in the vector diagram. If a three-phase distributing system contains a transformer supplying a low-voltage network, the voltage vectors of the primary will form a certain angle with those of the secondary, and this angle depends on the winding of the transformer. This angle, which is formed by the voltage vectors of two networks connected together by the transformer, is called by the author the "network angle" (netzewinkel). The condition which must be fulfilled if two three-phase transformers are to be connected in parallel is that their networks angles are the same. The author recommends to indicate the networks angle of a transformer on the name-plate of the machine.—*Elek. Zeit.*, Oct. 10.

Separating the Losses in Induction Motors.—W. Linke.—Bragstadt and LaCour have shown that the retardation method may be used for determining the friction and no-load losses in induction motors. For this purpose the machine is run as a synchronous motor, the rotor being excited by means of direct current in such a way that the phase difference in the stator is zero. By varying the frequency of the stator current, the watts are determined as a function of the number of revolutions. With the same direct-current excitation and, therefore, with the same flux, a retardation curve is then plotted, with disconnected stator. The present author shows that this method in connection with a no-load test may be used for determining the iron losses caused by the flux pulsations in the teeth.—*Elek. Zeit.*, Oct. 3

Lamps and Lighting.

New Lamps.—Notes on two recent British patents of the British Thomson-Houston Company. One refers to a graphite filament. Pure graphite, produced by heating a deposit of lampblack in an electric tube furnace to 3000 deg. C., is mixed with some suitable binder to produce a plastic mixture. This is squirted or otherwise shaped into threads or filaments, which are then heated to 400 deg. C. to carbonize the binder and produce a filament entirely of graphite. The filament is then mounted on lead wires and heated with a current in a vacuum. The second patent refers to a magnetite flame arc lamp. The electrode consists of a sheet-iron envelope having a metal closure at the bottom and contains a filling of 30 parts of rutile, 70 parts of magnetite, and 12½ parts of chromite mixed with ¼ per cent of sodium fluoride. When the electrode is in use, the sheet-iron envelope burns away with the filling, so that the end of the electrode presents a smooth surface, and a dense cap over the surface, which is sufficiently conductive to permit the relighting of the arc without difficulty.—Lond. *Elec. Eng'ing*, Oct. 31.

Arc Lamps.—O. Arendt.—An illustrated article on recent practice in the construction of electric arc lamps with vertical and slightly inclined electrodes. The latest construction of the Beck lamp is described. It operates with constant distance between the electrodes. Tests of Wedding with flame-arc electrodes 7 mm. or 8 mm. in diameter gave a mean hemispherical candle-power of 2469 for a mean voltage of 44.2 and a mean current of 9.1 amperes, and a specific power consumption of 0.163 watt per candle-power. Since the distance between the electrodes is constant, pulsations of voltage would cause pulsations of the current. These are avoided by using in series with the lamp a ballast resistance of the same type as used with Nernst lamps.—*Elek Zeit.*, Oct. 10.

Flame Arcs.—Illustrated notes on an experimental display of electric street lighting in a London city with centrally-hung flame arc lamps. They are to be hung and maintained at a rate of $87.50 each per year, all costs of the experimental installation being borne by the company. Two types of lamps are used, both with long-burning hours, one lamp being of the magazine type, while the other lamp is of the multiple electrode variety.—Lond. *Elec. Eng'ing*, Oct. 31.

Power.

Power Plant.—An illustrated article on electric power supply in Yorkshire. Considerable progress has been made during the last two years in the supply of the Yorkshire Electric & Power Company. The power house now contains three 2000-kw Curtis turbo-alternators. An improvement has also been made in the boiler house, which enables the boiler feed make-up water to be obtained from the canal instead of from the town pipes as formerly. This improvement consists in the installation of a rotary sand filter, of the Lassen & Hjort type, through which part of the condenser circulating discharge water is passed, and then delivered both warm and clean to the hot-well. The filter

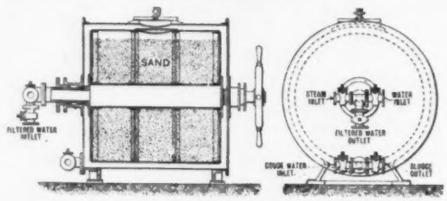


FIG. I.—DIAGRAMS OF FILTER.

is shown in Fig. 1, and consists of an external mild steel plate drum, designed for the required pressure. Within this is a second drum, perforated all over, and revolving upon a hollow spindle fitted with glands. The inside drum is partially filled with silicate sand. The water to be filtered enters at the bottom of the outer drum, envelops the internal drum, and passes through the sand into the hollow shaft, and away through the filtered water outlet. For cleaning the filter the flow of the water is reversed and the sludge outlet is opened, while simultaneously the inner drum is revolved to agitate the sand. The area of supply served by the company comprises 1800 sq. miles in extent, with an aggregate population of 2,800,000, and an aggregate industrial power demand of 2,000,000 horse-power. The connections are now increasing rapidly, and it is expected that by February of next year the output will reach a quarter of a million kw-hours per week. In most cases the energy is charged for by making a rate per kilowatt of maximum demand and adding a charge per kw-hour consumed, according to a sliding scale dependent upon the extent of consumption. This method encourages consumers to increase their load factor; the station load factor is well above 30 per cent. Three-phase currents at 10,000 volts are transmitted to nine substations, where the e. m. f. is reduced to 2000 volts.—Lond. *Electrical Eng'ing*, Oct. 31.

Chili.—Some notes on the development of water power in Chili. For instance, at Santiago a 20,000 horse-power scheme is being developed at 16 miles from the city. A report is also given by Prof. A. E. Salazar on the proposed electrical equipment for the railway from Arica to Tacora (100 miles). The single-phase system is recommended, and an increased economy is expected.—Lond. *Electrician*, Nov. 1.

Gas Engines and Steam Turbines.—E. J. Fox.—A communication criticising some figures in the recent comparison by Andrews between gas engines and steam turbines. It is claimed that Andrews' figures are too favorable to gas engines.—Lond. *Elec. Eng'ing*, Oct. 31.

Traction.

London.—An abstract, with an editorial discussion, of the accounts of the London County Council tramways. The chief points brought out in the report are the much better financial results obtained with electric traction than with horse traction, and the decrease in the cost per car-mile for electric working, due to the erection of their own generating station.—Lond. *Electrician*, Nov. 1.

Speed Regulation.—P. Dawson.—In a continuation of his long illustrated serial on electric traction on railways, the author tells how to ascertain the resistances required for speed regulation with direct-current traction motors.—Lond. *Electrician*, Nov. 1.

Installations, Systems and Appliances.

Electricity Supply in France.—Some statistical figures on central stations in France. On Jan. 1, 1907, there were 1413 generating stations which supplied 2912 towns with energy for lamps and motors. There were besides 824 gasworks, supplying 1209 towns. Each station supplies energy to the inhabitants of one or more towns. In each of four departments there are more than 100 villages connected to one station, and each of 12 departments there are over 50. The Department of Isere contains the greatest number of stations, namely, 60. There are 942 direct-current and 157 single-phase, 20 two-phase and 256 three-phase alternating-current stations. The remaining 38 stations supply both alternating and direct current. More than two-thirds of the stations, viz., 1000, are driven by water-power, 831 of these have water turbines alone, while 124 have also a steam reserve; 306 stations are steam-driven, 71 are worked by gas engines (including 43 by power-gas) and 10 are provided with oil engines.—Lond. *Electrician,* Nov. 1.

Lightning Arresters.—F. NEESEN.—A comparison of various types of lightning arresters with instructions as to their construction so as to be most efficient.—*Elek. Zeit.,* Oct. 3.

Electrophysics and Magnetism.

Production of Static Electricity by the Action of Heat and Light.—G. MELANDER.—The author thinks that a connection exists between the intensity of sunshine and the phenomena of terrestrial magnetism, and that it is not improbable that the rays of the sun are the indirect cause of the magnetism of the earth, the earth currents being the effect of sunshine. He has made a number of interesting experiments in which plates of different substances were exposed in sunshine and their electric charge before and after exposure measured. In making the experiments he observed that a piece of paraffin wax and a sheet of gutta-percha, which had lain in the dark for at least a year, even before exposure showed a negative charge; a stick of sealing-wax which had lain in the ordinary light of a room showed also slight negative charge; while the charge on an old ebonite plate and on a glass rod were scarcely perceptible. After exposure to sunlight all these bodies were charged; the paraffin, gutta-percha and sealing-wax were highly charged, the charge on all three being of negative sign. The ebonite plate showed a slight negative, and the glass rod a strong positive charge. One-half of the glass rod was rough and the other half smooth, but both parts were positively charged by exposure. With artificial sources of light (like a bunsen flame, the mercury-vapor lamp, arc lamps) very much smaller effects are obtained. The active rays are specially strong in sunlight and are not stopped by a glass window. The author then discusses the excitation of electricity by friction, and describes various experiments in this respect. When two pieces of paraffin, which have the same temperature, were rubbed one with the other, both pieces were negatively charged, but by keeping the temperature of one piece of paraffin higher than the temperature of the other, the warmer piece shows after rubbing a positive charge and the colder a negative charge. Similarly a glass rod, rubbed with a piece of woolen cloth was positively charged, but if the same woolen cloth before friction was made very hot, the same glass rod showed after rubbing a negative charge. The author proposes the following hypothesis. He thinks the different bodies at the same temperature may be in different electrical states. He calls this state the "electron temperature" of the bodies and he thinks this temperature is very different from the ordinary molecular temperature. By rubbing two bodies one with the other, the body which has the lower electron temperature is negatively charged and the other, which has the higher electron temperature, is positively charged, for the following reason: If two bodies have the same electron temperature, the electrons will be removed in the same proportion from both bodies. But if the electron temperature of two bodies is different, the number of electrons removed from the "electrically warmer" body will be greater than the number of electrons removed from the "electrically colder" body. The electrically warmer body will thus by rubbing be depleted of electrons and left with an excess of positive ions. It will, consequently, be positively charged. The electrically colder body will collect the electrons which the electrically warmer body has lost, and it will thus be negatively charged.—*Phil. Mag.,* October.

Magnetic Induction in Spheroids.—D. N. MALLIK.—A highly mathematical paper on the problem of magnetic induction in a magnetic substance in the form of a prolate spheroid, due to a current in a wire wrapped around it along a part of its length. —*Phil. Mag.,* October.

Electron Theory.—E. CUNNINGHAM.—A mathematical note on the electromagnetic mass of a moving electron, with respect to an objection raised by Abraham to Lorentz' hypothesis of the form of an electron.—*Phil. Mag.,* October.

Radium Emanation.—G. RÜMELIN.—An account of a determination of the period of radium emanation (or the time required for the emanation to be half transformed), which is found to be 3.75 days, agreeing very closely with the original value of Rutherford and Soddy.—*Phil. Mag.,* October.

Units, Measurements and Instruments.

Direct-Current Moving-Coil Galvanometer.—A. SCHORTAU.—An illustrated description of a new direct-current galvanometer,

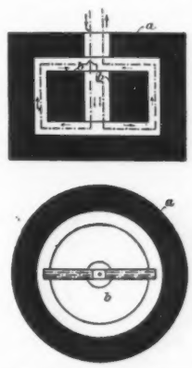


FIG. 2.—DIAGRAM OF GALVANOMETER CONSTRUCTION.

the construction of which is shown in Fig. 2. The cylindrical iron frame *a* forms one pole shoe of the permanent magnet. The other pole shoe *b* of the same magnet is an iron cylinder placed concentrically within the frame, so that the whole air-gap between the two cylinders is filled with lines of flux of uniform density. Within the air-gap a double coil is suspended. The two halves of their windings are either connected in series and wound in opposite directions, as shown in Fig. 2, or are connected in parallel and wound in the same direction as shown in Fig. 3. When a current passes through the coil, the coil moves under the influence of the magnetic field. By connecting two coils together it is possible to increase the torque and the sensibility. Further, since the flux density is the same at all points of the magnetic field, the angle of deflection of the coil must be proportional to the current. This is, indeed, the

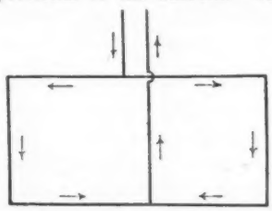


FIG. 3.—DIAGRAM OF WINDINGS.

case in the instruments as constructed. The air-gap is only one-half that of the Deprez d'Arsonval type.—*Elek. Zeit.,* Oct. 3.

Meters.—The Engineering Standards Committee has issued a standard specification for motor meters for electric supply consumers. A new departure is to fix a limit of inaccuracy at loads under one-tenth full load for all sizes. The meter must be capable of running on a minimum current equal to the one-hundredth part of its rating, and must start running and continue on this current when it is not less than one-tenth of an

ampere. The meter must be able to withstand an overload of 25 per cent for one hour without impairing its working or accuracy, or a current in the main circuit 30 times the ordinary rating for a period of half a second, and it must be able to withstand a 10 per cent pressure variation, or a 5 per cent frequency variation in alternating-current circuits with an error of not more than 1 per cent. The committee has defined very minutely the construction of the instrument with regard to the prevention of dust getting into the works, improper adjustments, or the interference of the purchaser with the mechanism, also defects in the construction and workmanship. A time limit of three years is fixed during which the manufacturer is liable for any defects for meters whose seals are intact.—Lond. *Elec. Eng'ing,* Oct. 31.

Induction Meter.—An official communication from the Reichsanstalt in which the admission for calibration of a single-phase induction meter of the Isaria Meter Company is recorded and the construction and operation of the meter is described in detail with illustrations.—*Elek. Zeit.,* Oct. 10

Megger.—Some illustrated notes on some recent forms of insulation and resistance-measuring sets of English make, called the "megger," and consisting of a combined ohmmeter and hand-driven generator. In one type an additional resistance box is provided for the accurate measurement of low resistances. Several illustrations are given. The principle has been noticed before in the Digest.—Lond. *Elec. Eng'ing,* Oct. 31.

Measurement of Mutual Inductance.—A. Campbell.—An account of a method measuring mutual inductance by a modified Carey-Foster method, with the aid of a vibration galvanometer. —*Phil. Mag.,* October.

Standard Cells.—F. A. Wolff and C. E. Waters.—A paper giving preliminary specifications for Clark and Weston standard cells. The Clark cell is defined as a voltaic combination having as its positive electrode pure mercury covered with a paste consisting of pure mercurous sulphate mixed with finely divided mercury and pure zinc sulphate crystals and solution, and as its negative electrode an amalgam containing 10 per cent by weight of pure zinc, covered with a layer of pure zinc crystals, the electrolyte being a solution of pure zinc sulphate in saturation equilibrium with the other constituents of the cell. The Weston cell is defined as a similar combination in which the zinc sulphate is replaced throughout by cadmium sulphate and the zinc amalgam by an amalgam containing 12.5 per cent by weight of pure cadmium. The purification and preparation of the different materials is described in detail, and in various cases several different methods are given.—*Bulletin, Bureau of Standards,* Vol. III, No. 4, October.

Series-Parallel Lamp Resistor.—N. T. M. Wilsmore.—A Faraday Society paper describing the arrangement shown in

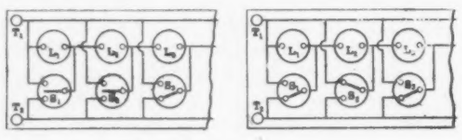


FIG. 4.—LAMP RESISTOR.

Fig. 4. In the figures only three lamps are shown, but the number may be increased indefinitely. The lamp sockets, L_1, L_2, L_3, etc., are connected in series with each other, and with the terminal T_1; but, by means of the two-way switches, S_1, S_2, S_3, etc., they may be connected in several different ways, so that a wide variation in resistance between the terminals T_1 and T_2 may be produced. Thus with three lamps of the same size, the following six combinations are possible: Three lamps in series (left-hand diagram); two lamps in series, one lamp; one lamp in parallel with the other two in series, two in parallel or three in parallel (right-hand diagram). However the switches are moved it is not possible to cause a short between T_1 and T_2.—Lond. *Elec. Eng'ing,* Oct. 31.

New Hole Interrupter.—W. von Uljanin.—A description of a new and convenient form of the hole interrupter which works for months without giving trouble. For diaphragms the author uses thimble-shaped tubes of thin porcelain, made at the Imperial German Porcelain Factory. Each porcelain tube has a small perforation in the bottom, from ⅛ mm. to 2 mm. in diameter. The thimble is inserted in the bottom of a beaker in a hole bored for the purpose of receiving it, and is held in position by a short length of india rubber tubing, which surrounds it. The beaker is placed in a larger vessel containing the same kind of liquid as does the beaker. The electrodes are thin leaden pipes, bent in spiral coils, one inside the beaker and one outside it in the larger vessel. The latter is bent so as to envelope the lower portion of the thimble. The two ends of each coil emerge from the liquid, and during the action of the interrupter cold water is kept running through them. In this way any heating of the interrupter is prevented. The author has succeeded in working it with strong currents, as high as 12 amperes, using in this case the larger hole. If the beaker has several holes in the bottom, several thimbles may be inserted and kept in reserve by closing them up with india rubber stoppers.—From *Phys. Zeit.,* Oct. 15; abstracted in Lond. *Elec. Eng'ing,* Oct. 31.

Battery for Testing Mains.—A letter and a note on batteries for the testing of mains. A set of small, portable dry cells is suitable, but the old-fashioned portable batteries of wet Leclanche cells last much longer if used carefully. An ideal battery for the testing of mains would be a set of well insulated secondary cells with a viscous or pasty electrolyte.—Lond. *Elec. Eng'ing,* Oct. 31.

Resistance Thermometers.—H. C. Dickinson and E. F. Mueller.—The authors describe a special form of electric resistance thermometer intended for calorimetric work. It has been found applicable for general temperature measurements in the interval between zero degree to 100 deg. C. The transition temperature of sodium sulphase has been redetermined, and found to be 32.384 deg. C. for the purest salt.—*Bulletin, Bureau of Standards,* Vol. III., No. 4, October.

Standard Scale of Temperature.—C. W. Waidner and H. C. Dickinson.—A long paper on the standard scale of temperature in the interval from zero to 100 deg. C. This standard scale is the scale of the constant-volume hydrogen-gas thermometer. The conclusion reached in the present paper is that the standard scale of temperature of the Bureau of Standards within the above interval, as defined by their standard mercury thermometers and with certain corrections, is in agreement with the hydrogen scale of the Bureau International to within the limits of accuracy at present attainable in mercurial thermometry, which may be about 0.002 deg.—*Bulletin, Bureau of Standards,* Vol. III, No. 4, October.

Telegraphy, Telephony and Signals.

London Telephone Exchange.—W. U. Lunnon.—An illustrated description of the equipment of the new Gerrard telephone exchange in London. The change-over from the old to the new exchange recently took place successfully. A feature of the switchroom is that, while the subscribers' lines are multipled over every six panels of the junction sections of the switchboard, they are only multiplied over every nine panels of the subscribers' sections. The switchboard is made up of eight-panel sections, each equipped for three operators' positions. One hundred and three subscribers' positions and 41 junction positions are already equipped, dealing with 7840 subscribers' lines and 1101 in-coming junction lines. Four-party line ringing keys have been fitted on the subscribers' positions. A plugging-up circuit of new design is used, capable of dealing with any kind of fault. In the apparatus room, the cables are brought to the vertical side of the main frame, on which side are the fuses, lightning arresters and heat coils.—Lond. *Elec. Eng'ing,* Oct. 31.

Condensers and High-Frequency Circuits.—W. Hahnemann and L. Adelmann.—An account of an experimental investigation of the losses in condensers with solid dielectrics and their damping effect in closed high-frequency oscillating circuits.—*Elek. Zeit.,* Oct. 10 and 17.

High-Frequency Oscillations.—J. Sahulka.—By connecting a Nernst-lamp filament in parallel with an oscillating circuit

(in an analogous way, as in Duddell's experiment with an arc lamp) the author endeavored to produce high-frequency oscillations, but was unsuccessful.—*Elek. Zeit.*, Oct. 24.

Electrolytic Wave Detector.—M. TISSOT.—The electrolytic detector which has been in use for several years for the telephonic reception of wireless telegraphic messages is, in principle, a voltmeter with two very unequal platinum electrodes immersed in sulphuric or nitric acid. As usually employed, a constant e. m. f. is applied to it, the fine point being the anode. A telephone in the circuit yields a sound when the voltmeter is submitted to the action of a train of waves. The author has compared the indications of the electrolytic detector (using a galvanometer instead of a telephone) with the bolometer. From his measurements he infers that the direct current resulting from the action of the waves on the electrolytic detector is proportional to the square of the amplitude of the oscillatory current in the receiving antenna. Nernst's theory of the concentration charges at the electrodes is then applied to this case, and is shown to represent the facts.—Lond. *Elec.*, Oct. 18.

Wave Detector.—An account of a recent British patent of R. A. Fessenden for a detector for wireless signalling. It is an electrolytic detector in which the gas from the fine platinum point is carried by a current of liquid to a narrow tube, which it partially obstructs, and thus interrupts a local current.—Lond. *Elec. Eng'ing*, Oct. 24.

Cable.—An illustrated description of the new West Indian cable recently laid between New York and Havana. Two types of deep-sea cables are employed, and two weights of intermediate cable. A rock cable is used at the Havana shore end and in this the cores are laid sheathed, in addition to being bronze-taped.—Lond. *Elec. Eng'ing*, Oct. 24.

Miscellaneous.

Meeting of Electrical Engineers of Switzerland.—An account of the general joint meeting, held at the end of September in Luzerne, by the Swiss Electrical Association (president, Nizzola; number of members, 802), the Association of Swiss Electricity Stations (president, Zaruski), the Incandescent Lamp Buying Syndicate (president, Wagner), and the Association of Swiss Electrical Contractors (president, Kummler). The representative of the Swiss Railway Department had formerly suggested to the electrical engineers to get together and agree on a certain electric traction system as the most suitable for operating the Swiss Railways. A report was presented by Prof. Wyssling for the committee for studying electric traction in Switzerland, an abstract of which will be found under Traction. The technical testing stations of the association have done a great deal of work during the past year. In discussing the incandescent lamp situation, it was emphasized on all sides that it is important to get better lamps, and that a somewhat higher price for the lamps should not prove an obstacle. The difference in the price might be made up by the electricity works, since they then would be in a position to give better light to their consumers.—*Elek. Zeit.*, Oct. 24.

BOOK REVIEWS.

RECIPES, FORMULAS AND PROCESSES. Edited by Gardner D. Hiscox, M. E. New York: Norman W. Henley Publishing Company. 787 pages. Price, $3.00.

This volume, the full title of which is "Henley's Twentieth Century Book of Recipes, Formulas and Processes," is stated in the sub-title to contain nearly 10,000 selected scientific, chemical, technical and household recipes, formulas and processes for use in the laboratory, the office, the workshop and in the home. The compiler states that in selecting the matter for the book he drew only from trustworthy sources, and modified such formulas as he considered ill-adapted in their original form for the needs of every-day life. The text is intelligently arranged and adequately cross-indexed, and the book is well printed and bound. A glance through the pages indicates that the matter has been carefully selected, both with respect to subject and to the present state of the arts to which the recipes apply.

PRACTICAL ILLUMINATION. By James R. Cravath and Van Rensselaer Lansingh. New York: McGraw Publishing Company. 361 pages, 385 illustrations. Price, $3.

Until within comparatively few years electric lighting as an art dealt directly only with the generation of power and its transformation into light. While every detail up to the utilization of the light had received most minute attention in theory, design and construction, lighting plans were in most cases left to the draughtsman of the architect or of the wire contractor, who, with no knowledge of the principles of illumination, located lamps in accordance with the most primitive considerations. The late Luther Steiringer was, perhaps, the first who sought to bring illumination to the stage of an art, and the classical book by Dr. Louis Bell, "The Art of Illumination," originally published about seven years ago, was the first systematic treatise on the subject. While it is only within the past two or three years that the desirability of applying scientific engineering principles to everyday problems of artificial illumination has become generally recognized, the advancement in that short period has been so rapid that illuminating engineering has now become definitely established as a specialty. For its practice, however, there has been a great dearth of specific engineering data, and the present work, having for its leading object the supply of this deficiency, is, therefore, particularly welcome.

Some of the chapters of the book are revisions and enlargements of articles by the authors which have appeared from time to time in the past two years in the columns of the ELECTRICAL WORLD. Much other matter has been added, however, including chapters on gas lamps and comparisons of illuminants. The first part of the book is devoted largely to curves showing the distribution of light about incandescent electric lamps, gas burners, gas and electric clusters, Nernst lamps, arc lamps and mercury-vapor lamps equipped with various forms of reflectors, shades and globes. Considerably more than 100 photometric curves of this kind are shown, practically all the result of tests made at the Electrical Testing Laboratories in New York. These tests cover most of the common forms of glassware used with gas and electric lamps, and are of the greatest importance to the engineer in planning effective illumination. Chapters on the laws and measurement of light, calculation of illumination and the physiological effect of light with respect to the eye—a most important consideration in practical illumination—are also included in the early part of the book. A chapter on comparisons of illuminants gives the mean spherical candle-power of all the common electric and gas lamps, the data being taken from the most authoritative sources available. An interesting chapter is on "Demonstration Room Tests," in which is shown a set of engravings made from photographs of a pair of rooms, side by side, of exactly similar dimensions and color. In these rooms incandescent lamps, equipped with different kinds of shades and globes were compared to determine the relative effect of the glassware in modifying the distribution of light. These tests show to the non-technical mind the effect of different glassware in a much clearer manner than photometric curves. The latter half of the book is devoted to a discussion of examples of interior lighting. A chapter is devoted to the principal classes of interior lighting, including residence lighting, office lighting, public halls, theaters, churches, stores, shops, factories and many other classes. In these chapters numerous illustrations are presented of rooms with good and bad lighting arrangements, the reason for the success or failure of the design being pointed out in the text. This method enables the essential features of good and bad design to be presented much more clearly than by simply discussing general principles without examples to illustrate them. In fact, the book makes no attempt to take up general principles at length or to go into the historical or extremely scientific and technical portions of the subject. The aim of the authors appears rather to have been to give specific practical information of a kind that has heretofore been largely lacking and to present it in such shape that it can be easily understood by non-technical men as well as engineers. The information contained on the light distribution

from various illuminants is particularly necessary to all who aim intelligently to plan illumination.

Recent discussions on central-station business methods have brought out clearly that no policy pays other than that of aiding consumers to obtain the most effective and economical illumination. Every central station, however small, should have one person on its staff who is, to some extent, at least, an expert on illumination, and to these the present book will be of the highest value, both for instruction in the art and for the practical data contained.

Reinforced Concrete. Part I. Methods of Calculation. By Albert W. Buel, C. E. Part II. Representative Structures. Part III. Methods of Construction. By Charles S. Hill. Second edition. New York: *Engineering News* Publishing Company. 499 pages, 80 illustrations. Price, $5.00.

In their preface the authors state that in preparing this work they had in mind a treatise for designing and constructing engineers, following American practice and governed by the conditions which prevail in America. Theoretical discussions are omitted in favor of practical working formulas, examples of representative structures, and records of actual practice in the selection of materials and of methods of workmanship and construction. The book is divided into three sections. In Part I are given working formulas for the calculation of the various classes of structures in reinforced concrete and such facts about the properties of concrete and steel as relate to economical engineering designs. Part II contains illustrations and descriptions of representative structures of reinforced concrete. Materials, workmanship and methods of construction are considered in Part III, and illustrated by examples from actual practice. In this part attention is given to the construction of centers and forms for concrete work and to methods of facing and finishing exposed concrete surfaces.

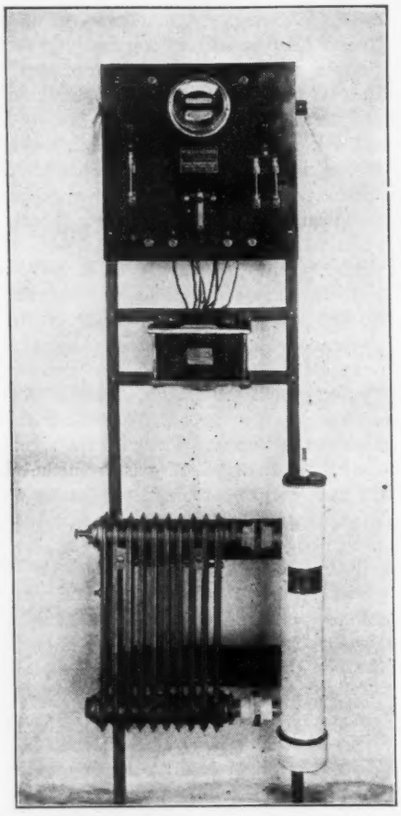
Electrolytic Current Rectifier.

The most interesting characteristic of aluminum is its asymmetrical resistance when placed in certain electrolytes. That is to say, the resistance is quite low for current in one direction but it is extremely high when the current reverses. This characteristic is caused by the formation of an insulating film on the aluminum surface by electrolytic action.

In the equipment illustrated herewith an aluminum cell with a special electrolyte is used for obtaining a unidirectional current when the supply e. m. f. is alternating. The rectifier proper consists of a circular iron tube about 4 ins. in diameter and 2 ft. in length, with which is connected a sheet-iron radiator through which the electrolytic compound circulates; the only other element is an aluminum rod which hangs in the center of the iron tube from which it is thoroughly insulated. The radiator serves for maintaining the temperature of the electrolyte at a safe value. In a 10-ampere rectifier operated at 133 cycles, the temperature of the solution reaches about 100 deg. F.; when the same equipment is used at 60 cycles, the temperature is very much lower. In either case the solution is kept in circulation, a result that contributes to the long life of the electrolyte and the electrodes.

The equipment illustrated delivers unidirectional current at 85 volts when the supply e. m. f. is 110 volts alternating. By the use of a small transformer the equipment may be rendered suitable for any value of supply e. m. f. The rheostat serves for adjusting the delivered current at any desired value from one ampere to the full rating of the equipment. An ammeter at the top of the board indicates the value of the unidirectional current delivered by the rectifier.

The type shown in the accompanying illustration is particularly arranged for charging small storage batteries for sparking and other purposes; as many as 30 cells can be charged in series at one time, taking from two to ten amperes. A larger type is designed for charging 24 or more cells of an automobile battery with a current not exceeding 25 amperes. These outfits are manufactured by the Eugene L. Richter Electric Company, 1914 Columbus Avenue, Philadelphia, Pa. They possess the advantageous characteristics of starting automatically when the circuit is closed, of requiring practically



ELECTROLYTIC CURRENT RECTIFIER.

no attention because there is no mechanism to get out of order, and of preventing the batteries from discharging into the supply lines when the circuit is broken.

Electric Switching Locomotive.

The Bush Terminal Company employs for switching purposes, around its extensive docks and warehouses in South Brooklyn, a number of steam locomotives and one electric

ELECTRIC SWITCHING LOCOMOTIVE.

locomotive. This latter was built by the General Electric Company about three years ago, and has given such satisfaction in the way of tonnage capacity, ease of control and low cost of maintenance that the company has recently given an order for a second electric locomotive.

The new machine has just been jointly completed by the General Electric Company and the American Locomotive Company. Some illustrations of this machine, presented in this article, show some features of the locomotive which are worthy of comment.

While the truck is a bar-frame equalized design, the construction adopted differs from that ordinarily used on electric motor trucks and follows rather a type which has been used with a good deal of success for the tender and guiding trucks of steam locomotives. The bolsters are carried rigidly on the side frames, and the weight of the frame and bolster is transmitted to the equalizers through one semi-elliptic spring on each side, instead of through bolster springs and helical side springs, as is the customary construction in the so-called M. C. B. equalized truck. This produces a simple, substantial form of truck suitable for locomotive service, and having a low cost of maintenance in such service.

Each truck is equipped with two 90-hp motors, with a gear ratio of 52 to 21. These motors, with this gearing, will give at their one-hour rating a tractive effort of 3000 lbs. per motor, or 12,000 lbs. per locomotive, at a speed of approximately 18 miles an hour.

The cab is built of sheet steel, supported by a frame work of small angle-irons, and consists of a main operating cab and sloping end cabs, with narrow side platforms extending from the main cab to the ends of the locomotive. The floor of the locomotive is of ⅜-in. sheet steel, but the floor of the main operating cab is covered with a ¾-in. wood covering.

Fig. 2 shows the arrangement of apparatus in the cab. The locomotive is provided with both straight and automatic air equipments. In the center of the main cab there is an air compressor, capable of compressing 50 cu. ft. per minute, and supplying air for the brakes. In the operating engineer's corner is located a master controller, and the valves and handles for operating the combined straight and automatic air. In the end cabs are located a sand box, air drum, contactors and rheostats. As the locomotive is to be used solely for switching service, it is supplied with a pantagraph trolley, thereby obviating the necessity of the frequent reversal of the trolley which would be necessitated in such service by a wheel trolley.

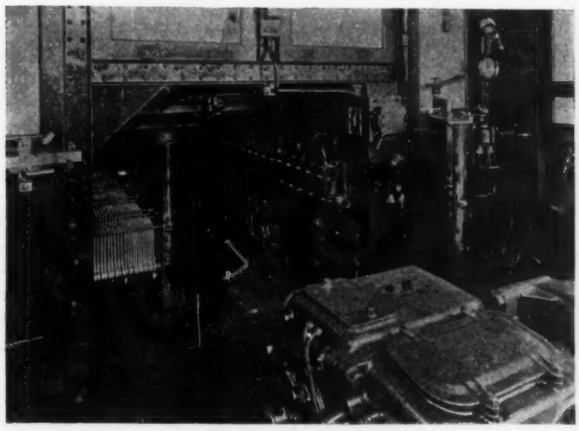


FIG. 2.—ARRANGEMENT OF APPARATUS IN CAB.

Portable Instruments for General Service.

Messrs. Machado & Roller, of New York, have brought out a line of portable instruments which have been designed with special reference to their use in general testing work. The instruments, together with a tool and utility box, are arranged for convenient handling as a unit by the use of a simple system of hooks and buttons. This is of great convenience, especially where the instruments must be transported to test apparatus in place and where time is a consideration, the unit forming a full testing equipment. The mechanisms are built solidly into their polished hard-wood carrying cases and the covering lids of the instruments are double hinged so that while the instruments may be thus entirely enclosed, leaving no projecting parts, the compartment enclosing the binding posts may be utilized for holding flexible leads and a moderate capacity shunt in the case of an ammeter.

One type of the unit system boxes is fitted with fibers, combined wire scraper and screw-driver, wire gage, screw wrench and foot rule, and the other type is merely an empty case large enough to carry a good-size shunt or such special tools and equipment as may be selected for individual needs.

FIG. 1.—PORTABLE TESTING INSTRUMENTS.

The direct-current instruments are of a wire-guided d'Arsonval type. The coil itself is rectangular, the wires being wound on a seamless metal frame whose vertical sides turn about the axis of the rectangle as a center in air gaps existing between the concave faces of the pole pieces of a permanent magnet and a cylindrical central iron core, in the conventional manner. In the "wire guided" mechanism, the coil *A*, Fig. 2, has attached to it ruby jewels, *B*, through which are pierced smooth cylindrical holes with rounded lips. Through these holes is threaded a length *C C* of hard drawn phosphor bronze wire of a diameter slightly less than that to which the holes were drilled and this wire, being tightly stretched and permanently secured at its ends to the U-shaped stationary frame-work of the instrument, thus forms a guide maintaining the coil truly centered with reference to the axis of the cylindrical iron core. To support the weight of the coil and prevent its touching the core, spiral springs *D D* have their one extremities attached to the coil, the other ends being stretched and secured to insulated brackets on the stationary framework. These springs also furnish the force opposing rotation of the coil when current exists and conduct the current in and out. If an instrument so built is dropped, the coil *A* will evidently dance up and down on its springs a few times without causing any damage. When in use and at rest, the coil moves with absolute freedom from

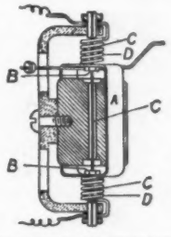


FIG. 2.—DIRECT-CURRENT INSTRUMENT MECHANISM.

frictional restraint other than the molecular friction of the metal of the springs.

The voltmeters have self-contained resistors. Ammeters of under 75 amperee capacity have their shunts self-contained, for convenience in higher capacity ammeters, the shunts are separate, being of the standard switchboard types, but with the clamp screws having wing nuts so that they may be tightened with the fingers if desired.

All the direct-current shunts give a uniform drop of 50 millivolts at their terminals when carrying full load, so that any number of different-capacity shunts may be used with a single instrument, the scale indications being multiplied by a suitable simple factor, according to the shunt selected. All separate shunt instruments are thus also millivoltmeters suitable for very low potential measurements.

The alternating-current instruments are of the hot-wire type and have been described in these columns before. The standard general service instrument case measures 6¾ ins. x 7½ ins. x 4 ins. The tool box is 6¾ ins. x 7½ ins. x 1¾ ins. and the utility box is 6¾ ins. x 5 ins. x 4 ins.

New Storage Battery Developed in Boston.

A new storage battery has recently been developed in Boston by Mr. E. C. Ekstromer, of Cambridge, Mass., which has been made the subject of an exhaustive study by Dr. William L. Hooper, professor of electrical engineering at Tufts College, extracts from whose report are given below.

The positive and negative elements of the Ekstromer battery consists of pasted lead grids, as do those of most other batteries, but by a special treatment the active material on these grids is rendered porous and, therefore, permeable to the electrolyte to a much greater extent, it is claimed, than in the case of other batteries. In the ordinary pasted grids the immediately useful part of the active material is limited to the relatively thin layer upon the surface of the plates that can be freely reached by the electrolyte, and the capacity of such cells is quite definitely limited to 0.28 to 0.30 ampere-hour per sq. in. of positive plate surface, which capacity per unit of area is, moreover, nearly independent of the size and thickness of the plate. In the Ekstromer cell the greater porosity of the active material allows the electrolyte to penetrate more readily and deeply, the active material, forming a deeper layer of immediately useful active material and resulting in a greater ampere-hour capacity per unit area of plate. Prof. Hooper states that he finds a capacity of 0.4 ampere-hour per square inch of positive plate for the Ekstromer cell.

The greater freedom with which the electrolyte reaches the active material results in less polarization, and the cells, therefore, yield a somewhat higher potential on discharge. The watt-hour efficiency is, therefore, somewhat higher. Dr. Hooper states that mechanical, as well as electrical, considerations demand that only a fraction of the thickness of mechanically stable plates shall be available for storage purposes; therefore, an obvious and necessary consequence of the greater porosity and ampere-hour capacity per unit area of the Ekstromer plate is that for a given weight of battery a greater output can be secured, and, on the other hand, a given number of ampere-hours can be secured from a lighter cell. Dr. Hooper's tests showed an ampere-hour efficiency of about 90 per cent and a watt-hour efficiency of about 85 per cent for the cell. In the accompanying table are given other results and data on six other cells of standard make, denoted by A, B, etc., compiled from figures published by their manufacturers.

The report shows that comparing the cells on the basis of ampere-hours per pound of weight, assuming the Ekstromer cell to have 8-lb. negatives, the average superiority is expressed by 85 per cent. Thus, an Ekstromer cell weighing 35¼ lbs. should have a capacity of $35 \times 7.11 = 250$ ampere-hours, and at 35 amperes should be discharged in seven hours. The cell denoted by D with 11 plates and weighing 35¼ lbs., has a capacity of 140 ampere-hours, and at 35 amperes could be discharged in four hours. The same cell weighing 27 lbs. would have a capacity of about 107 ampere-hours, and at 35 amperes would be discharged in about three hours. An Ekstromer cell weighing 27 lbs. is discharged at a 35-ampere rate in five and one-half hours. The above comparisons are based upon a somewhat lighter negative for the Ekstromer cell than was used in making up the test cell, but tests with the cadmium electrode seem to show that this decrease in weight can be made without reduction of capacity. The great porosity of the plate increases the effective area, and should enable the plates to stand up well under heavy discharges. Its construction should give it some degree of elasticity and thus enable it better to withstand the jolting of an electric vehicle. For stationary batteries where weight is of little account, Prof. Hooper states that a battery of Ekstromer plates of a given area will have about 40 per cent greater capacity than one of ordinary make of standard cells.

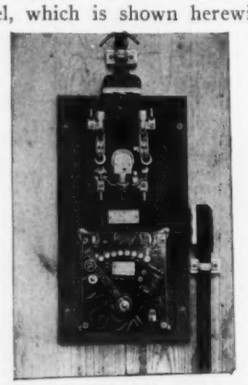
Name of Cell	Ekstromer	A	B	C	D	E	F
Plates:							
Number	11	9	11	11	11	9	9
Width, ins...	5¾	5¾	4⅞	4 13/16	5¾	5¾	7¾
Height, ins...	8⅜	8⅝	8⅝	8⅝	8⅝	8⅝	7¾
Sq. ins. of + surfaces ...	482	397	420	415	496	397	480
Weight, lbs...	22 3/16	24⅜	24¼	22	28¾	23½	39
Weight in lbs. cell complete.	27	30⅞	32	29¾	35¼	28¾	53
Discharges:							
Ampere for 4 hours	48	28	30	30	35	28	35
Ampere hrs..	192	112	120	120	140	112	140
Ampere hrs. per:							
Sq. ins. of + surface ...	0.4	0.282	0.286	0.289	0.282	0.282	0.292
Lbs. of plates.	8.65	4.6	4.95	5.45	4.87	4.77	3.60
Lbs. of cell..	7.11	3.63	3.75	4.03	3.97	3.90	2.64
Relative capacity:							
Unit area....	100	70½	71½	72	70.5	70.5	73
Unit weight..	100	51	52.7	56.7	55.8	55	—

During a recent discussion, Dr. Ekstromer stated that on a test an electric automobile of full weight was run 150 miles on one charge. A new factory is being equipped on Altro Street, Cambridge, Mass., by the American Electric Battery Company, for the manufacture of these cells on a large scale, and it is expected that the average output will be 1200 cells a week.

A report has also been made by Prof. John Stone, pointing out the usefulness of the battery in electric launch, vehicle, telephone, telegraph, lighting and power-station work. The manufacturing cost of the battery per pound is substantially the same as with other storage cells of the best quality, so that the manufacturing cost for a given capacity will be less.

Motor-Starting Panels.

The F. Bissell Company, of Toledo, Ohio, has brought out a new form of motor-starting unit which is said to combine all the safeguards required by the underwriters in such apparatus. The panel, which is shown herewith, is compact in design and is made in two types. The automatic circuit-breaker type permits of an adjustment to suit the load and does not require the use of fuses. The other type of panel is fitted with a knife switch and fuses. Either type of motor-starting panel may also be obtained with or without the starting rheostat.



MOTOR-STARTING PANEL.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—As a whole, trade was quieter and industrial operations are being curtailed by reason of the readjustment process necessitated by the prevailing financial stringency and the widespread scarcity of currency. On account of this, wholesale buying for future delivery was restricted; jobbing was confined to actual necessities and retail trade was curtailed by the necessary use of credit instruments. In manufacturing lines there is apparently a determination to fill orders only as they are received and an indisposition to accumulate stocks, the result being a slowing down of operations. The situation, however, is not without favorable aspects. Conservatism is the rule in the business community, and there is a steady determination to make the best of the situation. Favorable news comes from the agricultural sections in which the crops are being marketed as freely as the supply of money will permit. Manufacturing returns show an increase in idle machinery to prevent an accumulation of stocks during the period of cautious buying, and in some cases of lessened demand and lower prices wage earners have wisely accepted moderate reductions in pay in order to continue at work. Railway earnings thus far reported for the first week of November show a gain of 7 per cent over last year's figures. A better supply of railway cars is reported. Collections are poor and the banks are not making new loans. New business in all branches of the iron and steel trade was very quiet, and prices tended downward. In finished lines producers are disposed to grant requests for postponements of shipments. Coal is lower, owing to the money stringency. The demand for copper was confined mainly to small lots, and prices are easier. The closing quotations were 13⅜c. for Lake, 13⅛c. for electrolytic and 12⅞c. for casting stock. Bradstreet's reports 259 business failures during the week, which is the largest number of any week since January. In the week previous the number was 226, and in the corresponding week last year 222.

ALLIS-CHALMERS CONTRACTS.—J. G. Brill Company, of Philadelphia, has recently purchased an additional power unit for enlarging the present plant in the shape of an Allis-Chalmers 22-in. x 36-in. horizontal Reliance Corliss engine direct connected to a 300-kw direct-current generator, of the same build, for lighting and power service. The engine will operate non-condensing. The Steptoe Valley Smelting & Mining Company, of Ely, Nev., recently purchased through the American Smelters Securities Company, of New York City, six 150-hp Allis-Chalmers induction motors, each for operating on 60-cycle, three-phase, 550 volts at a speed of 600 r. p. m. The Northwestern Pacific Railroad Company, of San Francisco, a consolidation of the old North Shore and the San Francisco Northwestern Railway, now owned by the Southern Pacific System, has recently purchased additional power equipment for installation in the San Anselmo sub-station of the North Shore Railroad. This equipment comprises two 500-kw Allis-Chalmers two-bearing motor-generator sets, a 30-kw induction motor generator exciter set and three 300-kw oil-filled water-cooled transformers of 54,000 volts. The San Anselmo sub-station will receive three-phase, 60-cycle alternating current at 54,000 volts and furnish direct current at 600 volts and at 1200 volts by means of synchronous motors driving 600-volt direct-current generators through a double set of bus-bars. These synchronous motors will have normal rated full load capacity of 800 hp. The Buffalo Copper & Brass Rolling Mill, of Buffalo, N. Y., has recently purchased electrical equipment for the new plant at Black Rock Station consisting of a 500-hp and two 250-hp, 2300-volt, Allis-Chalmers variable speed induction motors. These units are for use in driving rolling trains in a copper mill where the chief product is the manufacture of copper sheets. Mr. B. J. Dashiells, C. E., is consulting engineer in charge of the new construction and equipment.

PLANTS IN JAPAN.—In the development of Japan the progressive Japanese make it a point to purchase nothing but the most up-to-date material. The Japanese were among the very first to anticipate that the turbine engine was to be the foremost power producer of the age and as a consequence a great many American turbine engines have been installed in that far-away country. A total of 69 units, aggregating 60,000-hp capacity, of the Curtis type of turbo-generator, manufactured by the General Electric Company, of Schenectady, N. Y., have been installed in that country. The 69 machines are distributed as follows: Chita Cotton Mill, one 25-kw unit; Fuji Cotton Mill, two 1000-kw units; Hskata Electric Light Company, one 500-kw and one 20-kw units; Ichinomiya Cotton Mill, one 25-kw unit; Imperial Steel Works, one 25-kw unit; Imperial Government Railway, one 35-kw unit; Kawasaki Dockyard Company, Kobe, one 500-kw unit; Kaneko Cotton Mill, Osaka, one 25-kw unit; Kure Naval Dockyard, one 500-kw unit; Maidzuru Naval Dockyard, one 300-kw unit; Miye Cotton Mill, Osaka, two 25-kw units; Miike Mine, Omuta, three 1000-kw units; Nisshin Cotton Mill, two 1000-kw units; Nagoya Electric Light Co., two 500-kw and one 25-kw units; Oji Paper Company, Oji, one 500-kw unit; Osaka Electric Light Co., four 500-kw and two 1000-kw units; Osaka Military Arsenal, Osaka, eight 500-kw units; Osaka Municipal Railway, three 1000-kw units; Sanyo Railway Company, one 25-kw and one 15-kw units; Saseho Naval Dockyard, two 500-kw units; Senju Woolen Mill, one 150-kw unit; Tokyo Electric Light Company, one 500-kw unit; Tokyo Military Arsenal, Tokyo, four 500-kw and two 500-kw units; Tokyo Military Arsenal, Oji, three 500-kw units; Tokyo Railway Company, five 1500-kw units; Tokyo Cotton Mill, three 1000-kw units; Tenma Weaving Company, two 25-kw units; Yokohama Union Electric Light Company, two 500-kw, one 1000-kw and one 1000-kw units.

TO MAINTAIN PRICES OF IRON AND STEEL.—The American Steel & Wire Company in a letter addressed to the managers of departments and salesmen enjoins price cutting to stimulate business on account of the falling off in demand. The salesmen are instructed to advise their customers that they will be protected in the matter of prices on the decline just as they were on the rise, which culminated last spring. The letter, which is signed by Vice-president Franck Baackes, says in part: "Indulge in no cutting of any kind; maintain schedule prices absolutely. This is no time to think of anything else. No additional sales would result from a drop of any kind, and I want to emphasize the point that you are not to sell the trade any more goods than they can take in and pay for. If this is not sufficient to take care of our production, the goods will not be manufactured."

WESTINGHOUSE MACHINE.—It is stated, from Pittsburg, that a plan has been prepared, to be submitted to the creditors, to take the Westinghouse Machine Company out of the hands of receivers and place it in the hands of a creditors' committee, giving the company a reasonable time to pay its indebtedness. The debt is to be secured by bonds now in the treasury. Statements of the condition of the company show it to be in excellent shape to meet all its debts if given reasonable time. The business is large and profitable, and nothing but patience on the part of creditors is needed to put the company's affairs in good shape.

PLANT FOR JAPAN.—The complete equipment for one of the largest flour mills so far erected in Japan was recently contracted for with Allis-Chalmers Company, Milwaukee, through the American Trading Company, Yokohama, Japan, for the Meiji Flour Mills. The capacity of the new mill will be 800 barrels of flour per day and the equipment comprises ten carloads containing 20 roller mills, bolters, centrifugal reels, purifiers and the usual complete complement of auxiliary and transmission machinery.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a more hopeful feeling in the stock market early in the week in view of the improved financial condition, but this was counteracted by reports of widespread curtailment in the iron and other industries, and by renewed liquidation in leading stocks, such as St. Paul and the Steel shares. The tone of the market at the close of the week was heavy and irregular at general concessions in prices. In the list of electric stocks General Electric and Westinghouse

experienced declines in the net results of the week's business. General Electric advanced to 114, but dropped to and closed at 103½, which is a loss of 10⅜, and Westinghouse ranged between 48 and 32. the latter being the closing quotation and representing a net decline of 17 points. Other stocks were quite steady in price, the tendency being upward. On the curb market prices tended toward a lower level, with renewed liquidation. Trading was on a smaller scale. Following are the closing quotations to Nov. 19:

NEW YORK.

	Nov. 11	Nov. 18		Nov. 11	Nov. 18
Allis-Chalmers Co.....	5¼	5	General Electric 112		105
Allis-Chalmers Co. pfd..	14½	14	Hudson River Tel.....	—	—
Am. Dist. Tel.....	20	20	Interborough Met. com.	5⅝	5
American Locomotive....	39	34½	Interborough Met. pfd..	17½	15
Amer. Locomotive pfd..	92½	90	Mackay Cos.	47	47
American Tel. & Cable..	60	60	Mackay Cos. pfd.....	53	52¾
American Tel. & Tel...	92	93	Marconi Tel.	—	—
Brooklyn Rapid Transit.	31½	30½	Metropolitan St. Ry....	20	23
Electric Boat	—	—	N. Y. & N. J. Tel.....	96	93
Electric Boat pfd.....	—	—	Western Union Tel...	64	62
Electric Vehicle	—	—	Westinghouse com.....	44	34
Electric Vehicle pfd...	—	—	Westinghouse pfd.....160		160*

BOSTON.

	Nov. 11	Nov. 18		Nov. 11	Nov. 18
American Tel. & Tel...	92	93¼	Mass. Elec. Ry. pfd...	40	38
Cumberland Telephone..	—	—	Mexican Telephone....	1¼	—
Edison Elec. Illum.....195		195½	New England Telep....	98½	96
General Electric	—	107	Western Tel. & Tel....	4	4
Mass. Elec. Ry.....	9¾	9½	West. Tel. & Tel. pfd..	53	50

PHILADELPHIA.

	Nov. 11	Nov. 18		Nov. 11	Nov. 18
American Railways ...	44½	44½	Phila. Electric	6⅜	6⅝
Elec. Co. of America...	8	8	Phila. Rapid Transit...	16	12½
Elec. Storage Battery..	30	31¼	Phila. Traction	83	82½
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Nov. 11	Nov. 18		Nov. 11	Nov. 18
Chicago City Ry.....140		150*	National Carbon	50	—
Commonwealth-Edison ..	80	—	National Carbon pfd...	99	—
Chicago Subway	12¾	—	Union Traction	—	—
Chicago Tel. Co.....110		105	Union Traction pfd....	—	—
Metropolitan Elec. com.	19*	19*			

*Asked.

NORTH AMERICAN EARNINGS.—In discussing the affairs of the North American Company the *Wall Street Journal* says: The statement of earnings put out by the company for the ten months ended Oct. 31, 1907, is not entirely reassuring. It shows that during the period the North American Company's net income was equal only to 4.29 per cent on its $29,791,300 outstanding capital stock. If its net income for the remaining two months of the year is in the same proportion, which it may be or may not be, the total net income for the year will be equal only to 5.15 per cent, thus giving practically no margin for the 5 per cent dividend. As a matter of fact the actual net income of the company in the past has been inadequate to meet 5 per cent dividends on the present capitalization. The company has followed the practice of including in its income account the increase in value of assets as readjusted by it at the end of each year. By this means large earnings for the stock have been shown. This is shown by the following table, giving for three years the total earnings, as given by the income account, the charges and the amount and percentage earned on the stock by this method of computation:

	Total Earnings	Charges	Earned on Stock	Per Cent
1906.....	$2,773,892	$99,270	$2,674,622	8.97
1905.....	2,298,613	97,628	2,200,985	7.38
1904.....	1,670,985	78,324	1,592,661	5.34

The percentage earned on the stock as shown above is on the basis of the present amount outstanding, $29,791,300, the total outstanding having been increased in the last two years. As shown above, the company earned during the year ended Dec. 31, 1906, an amount equal to 8.97 per cent on its stock, which would leave a wide margin for the 5 per cent dividends. As a matter of fact, however, there was included in the income account an item of $1,721,500, representing the increase in the value of assets as readjusted. Deducting this amount, as not consisting actually of income, there remained an amount equal only to 3.19 per cent on the stock. In the income account for the year ended Dec. 31, 1905, there was included $920,000 in the same way and in the income account for the previous year $701,119. After deducting these amounts the actual earnings for the stock on the basis of the amount now outstanding were as follows:

	Earnings After Charges	Deductions	Balance for Stock	Per Cent
1906.....	$2,674,622	$1,721,500	$953,122	3.19
1905.....	2,200,985	920,000	1,280,985	4.30
1904.....	1,592,661	701,119	891,542	2.99

There is no question that the value of the company's assets has increased with the years, as the time when it will receive larger returns in the shape of dividends on its securities draws steadily nearer. The company's equity in the earnings of its subsidiaries is increasing each year, and in the year ended Dec. 31, 1906, it amounted to $982,345. This amount is equal to 3.29 per cent on North American stock.

GOOD TELEPHONE EARNINGS.—In a letter to stockholders of the American Telephone & Telegraph Company, President Theodore N. Vail, speaking of the company's gains in earnings, says that for the 10 months ended Oct. 31, 1907, the net earnings were $13,715,000, against, for the same period in 1906, $11,579,000. October showed net earnings of $2,567,000, against $2,004,000 for October, 1906. The company has cash in banks of over $18,000,000, and will not have to do any financing until the requirements of 1909. The company has earned, in the first 10 months, its entire 8 per cent dividend for the year upon its enlarged capital with a balance of nearly 1 per cent to spare. A fairer comparison of earning capacity would be to take as the average amount of stock outstanding during the 10 months the $131,551,400 issued at the beginning of the year plus the first 50 per cent payment on the $21,925,200 stock offered in June, making a total of $142,514,000. On this basis the percentage of earnings was 9.6 per cent as compared with 8.8 per cent last year. The $13,715,000 of net earnings shown above does not by any means measure the full earning power of the parent company. For instance, on Sept. 30, at the end of the first three-quarters of the current fiscal year, there was a balance in round figures of $6,000,000 representing the undivided earnings of the 30 odd associate companies. The American Telephone Company share in this total may be roughly figured at 55 per cent—its percentage of the total outstanding stocks of all the sub-companies—or say $3,300,000. The addition of this sum to the actual net earnings of $13,715,000 gives a total of over $17,000,000, or better than 11 per cent on the full amount of stock now issued.

ELECTRIC MATERIAL COMPANY.—Cleveland P. Manning and Paul M. Burnett have been appointed receivers for the Electrical Material Company, 221 North Calvert Street, Baltimore, Md., after the company had been adjudicated a bankrupt with its consent. The receivers bonded for $30,000. Attorney-General Charles J. Bonaparte, to whom the company owes $2,500 on an overdue promissory note, is one of the creditors who petitioned to have the company adjudicated a bankrupt and for the appointment of receivers. Fred Diecken and Conrad Young, to whom the company owes $61.75 and $66.57, respectively, are the other petitioners. It was alleged in the petition that the company is insolvent, and it committed an act of bankruptcy on Nov. 4 by permitting its check for $1,000 to go to protest. The petition stated that the company has stock and fixtures valued at $20,000 and open accounts of about $30,000. The receivers were authorized to continue the business of the company until the further order of the court. Suit for the appointment of a receiver for the same company was instituted in Circuit Court No. 2 by Hugh G. Ferguson, trading as the United States Incandescent Lamp Company, through Carville D. Benson, attorney. The suit is based on alleged indebtedness of $2,290.

AMESBURY, MASS., LIGHTING.—The Gas & Electric Light Commissioners of Massachusetts had a recent hearing on a petition of the Amesbury Electric Light Company for permission to issue $50,000 of additional stock. The company was originally a side issue of a manufacturing concern whose business was unsuccessful, and when it was finally disposed of the electric light company had a deficit of over $25,000. By withholding dividends this has been reduced to about $8,000. The field has grown so that an enlargement of plant was necessary. This has been made, but a large floating debt has been incurred which it is now proposed to wipe out by the proceeds from the bonds. Meanwhile the majority of the stockholders have paid an assessment of $45 a share, but there are some twenty-five shares whose holders refuse to pay up. The company wants a condition put into the permission to issue bonds that no dividends be paid until the assessments on all shares have been paid.

UNION SWITCH & SIGNAL.—The Union Switch & Signal Company, one of the large Westinghouse concerns, makes the following statement of earnings for nine months ended Sept. 30:

	1907.	1906.	
Sales	$3,758,179	$3,699,796 Inc.	$58,383
Other income	23,959	2,842 Inc.	21,117
Cost of prod. and sales.....	$3,782,138	$3,702,638 Inc.	$79,500
Interest, etc.	2,928,805	2,974,706 Dec.	45,901
Net inc. (9 mos.).....	$853,333	$727,932 Inc.	$125,401

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Muscle Shoals Power Company and the Hydro-Electric Company are contemplating the construction of a series of three locks and dams across the Tennessee River near Muscle Shoals in Alabama for the purpose of securing power to generate electricity.

FORT PAYNE, ALA.—A company is being formed to be known as the Alabama Railway & Power Company to construct an electric railway which will connect Birmingham and Chattanooga and also furnish electricity for lighting. The officers of the company will be: H. T. Henderson, of Durango, Col., president; J. H. Hill, of Fort Payne, Ala., vice-president; C. L. Young, of Durango, Col., secretary and treasurer. The capital stock of the company will be $100,000.

TUSCALOOSA, ALA.—Bids will be received until Nov. 23 for the construction of the proposed engineering building and geological and biological laboratories for the University of Alabama. The engineering building will be of reinforced concrete and the equipment will include two 100-kw generators, direct connected; one 25-kw generator; water tube boilers of 500 hp capacity, with coal-weighing and ash-removal plant; mining and hydraulic equipment and heating plant, and complete equipment for physical, cement-testing and road materials laboratories. The Legislature has appropriated $500,000 for equipment and buildings, which is now available. Edgar B. Kay is dean of the Department of Engineering.

FORT SMITH, ARK. -The Nelson Investment Company has been organized with a capital stock of $100,000 for the purpose of constructing an interurban railway between Fort Smith and West Fort Smith, a distance of about ten miles.

GREEN FOREST, ARK.—The Farmers' Union Telephone Company has purchased the plant and system of the Green Forest Telephone Company in this place.

HOT SPRINGS, ARK.—Atwood Benton, of Kansas City, is making arrangements to install a new electric light plant in this city. Mr. Benton states that his company will have the plant in operation by April 1, 1908.

HOT SPRINGS, ARK.—The Southwestern Telegraph & Telephone Company has purchased the local exchange of the Southern Telephone & Telegraph Company and will make extensive improvements in the equipment and service. P. K. Baker is division superintendent of the Southwestern company.

SULPHUR SPRINGS, ARK.—Plans are being prepared by Smith & Powers for a combined electric light plant and water works system, to cost about $25,000.

COMPTON, CAL.—Work has been discontinued on the construction of the plant for the Compton Electric Light & Power Company, and an investigation is demanded by W. D. Gould, acting as attorney for the stockholders of the company, who declare they were mulcted in building the plant. E. Riveroll & Company are the contractors.

HANFORD, CAL.—The contract has been awarded for the construction of an interurban railway from Hanford to Kennewick, a distance of 75 miles, and machinery has been received for the power plant, which is to be located in Hanford. The plant will have a rating of 40,000 horsepower, and will furnish electricity to operate the road and for heating purposes, and will also furnish water for irrigation purposes.

LAKEPORT, CAL.—A. E. Dickinson, president of the Sonoma & Lake County Railway Company, states that all the rights of way, terminals and franchises have been secured and that work on the construction of the road will commence next spring. The road will connect Cloverdale, Lakeport and Kelseyville and will be 30 miles long. The company is capitalized at $1,000,000. Col. J. E. Fulton, of Lakeport, is vice-president and general manager.

NAPA, CAL.—The officials of the Standard Portland Cement Co. have decided to build a private electric railway from its plant to the bank of the Napa River, a distance of about two and one-half miles. The company has been obliged to close down its plant owing to the Southern Pacific Railroad being unable to supply it with cars in which to ship its product.

OXNARD, CAL.—The Ventura County Power Company has completed the construction of a 70-mile, 33,000-volt, 3-phase transmission line tapping the Edison Electric Company's 66,000-volt line. Sub-stations have been erected at Piru, Castaic, Fillmore, Santa Paula, Saticoy, Ventura and Oxnard. The steam plant at Oxnard will be used as an auxiliary, and the plants at Ventura and Santa Paula will be closed down. J. E. Barker is superintendent.

PASADENA, CAL.—The City Council has decided to ask for additional bond issues for completing the municipal electric light plant in two propositions, aggregating $200,000, to carry out the recommendation of the Cory report. One proposition is to issue $50,000 in bonds to complete the plant as it now stands, and the second to issue $150,000 to equip the plant for commercial lighting.

RICHMOND, CAL.—The Town Trustees have granted a franchise for an electric railway to W. S. Rheem.

SAN DIEGO, CAL.—The County Commissioners have granted E. W. Scripps permission to erect and operate poles, wires and conduits for a telephone and telephone lines in San Diego County.

SONORA, CAL.—The Tuolumne Electric Company is extending its transmission line to Confidence for the purpose of supplying electricity to the mines in the vicinity of Confidence and Tuolumne. The company has a contract to supply the Confidence mine with electricity by Jan. 1.

VALLEJO, CAL.—Bids will be received until Dec. 3 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for five induction motors, to be furnished at the navy yard, Mare Island, Cal., as per schedule 448. Applications for proposals should designate the schedule by number. E. B. Rogers, paymaster general, U. S. A.

BRIDGEPORT, COL.—J. S. Cain, V. Bernard and Mr. Woodbury, a Nevada mining man, have perfected right and title to the waters of Rush Creek at the power plant site, and work will be commenced on the plant early in the spring.

CRESTED BUTTE, COL.—The Crested Butte Light & Water Company has been incorporated with a capital stock of $50,000 by Henry C. Wright and others.

MERIDEN, CONN.—The Board of Public Works has entered into a contract with the Meriden Electric Light Company to furnish electricity to light the city for a term of five years. Under the terms of the new contract, which takes effect Dec. 1, the city will pay $100 per lamp per year, which is $20 less than the present contract, and by which the city will save $4,000 a year on the 200 lamps the company is now furnishing the city.

SMYRNA, DEL.—The Smyrna, Kent County & Delaware Bay Traction Company has secured the right of way through New Castle County within one and a half miles of Delaware City for an electric railway, work on which is expected to commence soon. The company also expects to construct a power plant at St. George. J. W. Endean is interested in the enterprise.

WILMINGTON, DEL.—The Commercial Light, Heat & Power Company has been granted an extension of time for twelve months from Jan. 1, 1908, by the Board of Sewer and Street Directors. The company was granted a franchise to begin operations in the city by June, 1907. Owing to the present condition of the money market the company is obliged to ask for a second extension of time.

ALBANY, GA.—Plans and specifications will be prepared by J. E. Sirrin, of Greenvile, S. C., for the Albany Power & Manufacturing Company for the development of 10,000 horse-power at Porter Shoals, on Flint River, where the company plans to build a dam and power plant and install machinery for generating and transmission of electricity. The present plant of the company has an output of about 3000 horse-power.

ANDERSON, GA.—The stockholders of the Savannah Power Company on Nov. 11 voted to authorize the directors of the company to transfer all its property to the Georgia-Carolina Power Company. The latter company was formed several months ago with a capital stock of $8,500,000 and is merging many companies on the Savannah and Tugaloo Rivers. The company will develop between 125,000 and 150,000 horsepower. H. A. Orr, of Anderson, is president of the Georgia-Carolina Power Company.

LA GRANGE, GA.—The city is contemplating increasing the capacity of the municipal electric light plant by the installation of additional boilers and engines, the cost of which is estimated at about $20,000.

MARIETTA, GA.—Application will soon be made for the incorporation of the Marietta-Macland Railway Company. The company proposes to construct an interurban railway from Marietta to Macland, thence to Powder Springs, Austell and on to Atlanta. It is said that prominent capitalists of Atlanta are interested in the project.

LEWISTON, IDAHO.—The Washington-Idaho Light & Power Company, which supplies several towns in Palouse County, purchases its electric energy for operating its system from the Lewiston-Clarkston Company and from the Washington Water Power Company. The towns of Pullman, Uniontown and Colton, Wash., Moscow and Genesee, Idaho, are supplied from the plant of the Lewiston-Clarkston Company, while the plant of the Washington Water Power Company supplies the towns of Palouse, Garfield, Oakesdale, Farmington and Tekoa.

MILNER, IDAHO.—Instructions have been received by Superintendent McWaters, of the North Side Twin Falls Land & Water Company, to start at once construction on the new electric railway from Gooding to Wendell. W. S. Kuhn, of Pittsburg, Pa., is president of the company.

MOSCOW, IDAHO.—The City Council is reported to be considering the question of establishing a municipal electric light plant.

KNIGHTSTOWN, IND.—The managers of the municipal electric light plant are contemplating increasing the output of the plant and will install a 100-kw, 2300-volt, 3-phase, 60-cycle Curtis steam turbine and two boilers of 175 hp each. F. S. Wilson is superintendent.

KOKOMO, IND.—W. T. Meck, city clerk, writes that the contract for lighting the city has been awarded to the Kokomo, Marion & Western Traction Company, of Kokomo.

LAFAYETTE, IND.—Bids will be received by the Board of Public Works at the office of E. H. Andrews, city clerk, until Dec. 20, for lighting the streets, alleys and other places of the city by electricity for a period of ten years from Sept. 1, 1908. R. H. McGrath is chairman Board of Public Works.

ODON, IND.—The Interstate Telephone Company has been purchased and taken over by William Wilgus, of Lafayette. Mr. Wilgus announces that he will purchase new equipment and otherwise improve and extend the system. The price paid for the plant was $20,000.

SEYMOUR, IND.—The City Council has granted a 20-year franchise to the Citizens' Mutual Telephone Company, a local company operating a rural system, to construct and operate a dual system in Seymour.

VINCENNES, IND.—It is reported that the Black Hawk Light, Heat & Power Company, recently incorporated with a capital stock of $1,000,000, will soon ask for bids for the construction and equipment of gas and electric plants. H. C. Bauer and M. Gentry are among the incorporators.

WASHINGTON, IND.—The City Council has decided to sell the 207 shares of stock which the city owns in the municipal electric light plant. The plant will be sold Dec. 16 to the highest bidder, the purchaser to operate the plant under the present franchise. The city purchased the plant several years ago for $80,000 and has been operating it at a loss ever since.

WILLIAMSPORT, IND.—It is reported that the Williamsport electric light plant, which was recently destroyed by fire, will be rebuilt at once.

ALBIA, IA.—The Albia Electric Light & Power Company is planning extensive improvements and extensions to its system, and will install a 200-kw generator for railway service, a 200-hp Ball engine, and construct four and one-half miles of track, and will also purchase four cars, 25-hp motors and two trailers. W. E. Gant is manager.

NEVADA, IA.—M. A. Harrison and H. H. Caughlin are reported to have purchased the electric light plant of the Nevada Electric Company and will make improvements.

OSKALOOSA, IA.—The Iowa Telephone Company is contemplating installing a new switchboard next season.

SIOUX CITY, IA.—The Automatic Telephone Company is making improvements to its plant and installing additional equipment.

VINTON, IA.—The Iowa Can Factory is in the market for a second-hand 10-kw, 110-volt, direct-current dynamo; could use a dynamo of 7½ kw. Dr. C. C. Griffin is president.

BELOIT, KAN.—The local electric light plant owned by A. T. Rogers has been purchased by the city.

PARSONS, KAN.—C. D. Moore, representing capitalists of Huntington, W. Va., has been granted a franchise by the City Council to construct and operate a street railway in this city. Mr. Moore and his associates contemplate building an interurban road.

LECOMPTE, LA.—The city is advertising for plans and specifications and for bids for installing an electric light plant to cost about $10,000. For further information address the Mayor.

BUCKSPORT, MAINE.—The Penobscot Bay Electric Company has applied to the Selectmen for a franchise to erect poles and wires on the streets and highways for the transmission of electricity in Bucksport.

BALTIMORE, MD.—It is stated that financial arrangements have practically been completed for the construction of the Baltimore, Halethorpe & Elkridge Railway Company's line from Baltimore to Halethorpe, surveys for which have been made and the right of way secured. Carville D. Benson is one of the incorporators.

AMESBURY, MASS.—The Amesbury Electric Light Company has applied to the Board of Gas and Electric Light Commissioners for permission to issue $50,000 of additional capital stock.

BOSTON, MASS.—The State Board of Railroad Commissioners have authorized the Boston & Worcester Street Railway Company to issue $300,000 in bonds.

CHELSEA, MASS.—The Chelsea Gas Light Company has announced a reduction in the price of electricity used for signs and outside lighting. The new rate is 10 cents per kw-hour, being a reduction of 37½ per cent from the present net rate of 16 cents per kw-hour.

NORTHBORO, MASS.—The streets of the town have been in darkness since the contract expired with the Blair Automatic Light Company Nov. 1, and unless some arrangement is made with the company will remain so for several weeks. TheMarlboro Electric Light Company has the contract for lighting the town, but will not have its system installed before Jan. 1.

PEABODY, MASS.—Owing to changes in the special committee on the electric light plant the committee has taken a different position in regard to the municipal electric light plant and will recommend the rehabilitation of the plant, rather than abandoning the generation of electricity and purchasing it from a power company. The committee will recommend an appropriation of $55,000 for three new generators, two new engines, a power line and other changes. No changes will be made in the boilers at present. The amount asked for is $20,000 less than that recommended by the auditing committee.

PLYMOUTH, MASS.—The Plymouth Electric Light Company has installed a 60-kw generator and made other improvements to its plant.

UXBRIDGE, MASS.—A new 300-kw generator has been placed in the plant of the Uxbridge & Northbridge Electric Company to furnish power for the street railway lines.

BAY CITY, MICH.—William H. Fitzhugh, superintendent of the municipal electric light plant, writes that all bids opened on Oct. 30 for two 250-hp boilers for the electric light plant have been rejected and that new bids will be received until Nov. 27 on new specifications. The lowest bid amounted to $9,800.

DETROIT, MICH.—The Detroit Traction Company, recently organized, has applied to the Common Council for a franchise to operate a street railway system in the city.

GARDEN, MICH.—The citizens of the village are contemplating the erection of a municipal electric light plant.

ISHPEMING, MICH.—The Marquette County Gas & Electric Company is planning to increase the output of its plant and make other improvements.

MUSKEGON HEIGHTS, MICH.—The city is considering the question of installing a municipal electric lighting plant.

NEGAUNEE, MICH.—A new 300-kw Westinghouse-Parsons turbo-generator has recently been installed in the municipal electric light plant. H. T. Pearce is superintendent.

OWOSSO, MICH.—The Owosso Light & Power Company has been organized by E. M. Hopkins, of Detroit, who will be president of the company, and Frank Wescott, of Owosso, treasurer. The company proposes to build a dam, 500 feet long and 30 feet high, at a point on the Shiawassee River, two miles and a half north of the city. The proposed plant will furnish electricity to operate the proposed Grand Rapids-Pontiac electric railway, and for light and power in Owosso. Work will commence on construction of the dam next spring.

PORT STANLEY, MICH.—It is reported that the citizens are considering the question of enlarging the municipal electric light plant in the near future.

SAGINAW, MICH.—The Board of Public Works has adopted a resolution notifying the telegraph and telephone companies and the electric light company to commence at once the work of placing their wires underground in Michigan and Washington Avenues, so as not to interfere with the paving of those streets, work on which will begin next spring.

GLENWOOD, MINN.—The owners of the Glenwood electric light plant are contemplating the installation of a 220-hp engine. H. Petersen is secretary.

LITTLE FORK, MINN.—Joseph E. Cummings, of Duluth, is contemplating developing the water power of Little Fork and Sturgeon Rivers for electrical purposes.

SAUK RAPIDS, MINN.—The City Council is contemplating establishing a pole line system for street lighting and will purchase electricity to operate same.

MERIDIAN, MISS.—The Meridian Light & Power Company is planning to extend its line to the south side of the city, work on which will commence soon.

NATCHEZ, MISS.—An ordinance has been introduced in the City Council to authorize the Municipal Water Works Commission to secure estimates on the cost of adding an electric light plant to the water works system to generate electricity for street lighting. The city now pays $15,000 a year for public lighting.

INDEPENDENCE, MO.—The City Council has instructed the light committee to increase the municipal street lighting system by the installation of 32 additional arc lamps. There are now 100 arc lamps in use.

MARYSVILLE, MO.—The capital stock of the Marysville Electric & Power Company has been increased from $25,000 to $35,000.

CHINOOK, MONT.—Bids will be received until Dec. 21 by the Town Council for the construction of an electric light system. John C. Duff is town clerk.

HELENA, MONT.—The forest service at Washington has decided to extend the telephone lines in the reserves of this state. Acting Supervisor George H. Cecil, of the Little Belt National Forest, has been authorized to expend $5,039 for the construction of telephone lines in his forest, which will provide for about 79 miles of new lines.

CLAREMONT, N. H.—L. N. Wheeler, manager of the Claremont Power Company, writes that the company is developing a hydro-electric power plant on the Black River, at Cavendish, Vt. The plant will have an output of 2250 horse-power, which will be transmitted to Claremont, a distance of 15 miles. The equipment of the plant will consist of three Pelton water wheels working under 120-foot head, direct connected to three 500-kw, 60-cycle, 3-phase, 11,000-volt generators; one turbine-driven exciter of 75 hp rating. Two Diesel oil engines, direct connected to a 300-kw, 60-cycle, 3-phase, 2300-volt, Fort Wayne generator, are being installed at the Claremont station, increasing the output of the plant to 500 horse power.

GRASSMERE, N. H.—The American Fiber Company has installed an electric plant to furnish electricity for lighting its mills, and is installing an electric motor to be used in addition to the water power.

HAVERHILL, N. H.—A contract has been made with the Bradford Electric Lighting Company to light the streets of the village for a term of five years. The company is now erecting poles and wires for the street lighting system, which will consist of 60 incandescent lamps of 32 candle-power.

MANCHESTER, N. H.—The Nashua Street Railway Company has been granted permission by the State Board of Railroad Commissioners to increase its capital stock by $25,000 to pay for improvements, which have already been made.

ASBURY PARK, N. J.—Three 500-kw Westinghouse-Parsons turbines are now being installed in the power station of the Atlantic Electric Railroad Company.

ATLANTIC CITY, N. J.—City Electrician A. W. Farrand has reported that it will cost $200,000 to place all of the electric lighting wires under ground in the city. Under an agreement between the city and the companies the work will be commenced in the spring and completed in three years.

EAST LAS VEGAS, N. M.—It has been decided to commence work on the construction of the Las Vegas-Mora Taos Electric Railroad at once. More than $80,000 of the $100,000 necessary to be subscribed in order to insure the construction of the road has been raised. W. A. Buddecke, president of the Las Vegas Railway & Power Company, is interested in the enterprise.

SILVER CITY, N. M.—The Silver City, El Paso & Southwestern Telephone Company has purchased the line of the Texas & New Mexico Telephone Company between Las Cruces and El Paso. The former company is a new company which is installing a long-distance line connecting El Paso, Las Cruces, Silver City, Deming and intervening towns.

GOUVERNEUR, N. Y.—It is stated that the International Pulp Company, which is building a large lace mill at Hailesboro, will construct a large electric power plant about a half mile above the mill.

LOCKPORT, N. Y.—The International Power & Transmission Company has renewed its application to the Common Council for a franchise to operate in the city of Lockport. The International company is a subsidiary of the Niagara, Lockport & Ontario Power and already has its lines erected to the city limits, where it is furnishing electricity to a factory. Secretary W. H. Higgs states that the company has a private right of way into the heart of the city.

PORTCHESTER, N. Y.—The Public Service Commission has granted the New York & Stamford Railway Company permission to double-track its railway in the towns of Larchmont, Rye and Portchester.

ROCHESTER, N. Y.—The Rochester Railway & Light Company has been granted permission by the Public Service Commission to supply electricity to the village of Irondequoit for light and power.

ROCHESTER, N. Y.—The Buffalo, Rochester & Eastern Railroad Company has applied to the Public Service Commission in the second district for authority to construct its proposed road from Troy to Buffalo. The company has been incorporated with a capital stock of $3,500,000, and asks for permission to operate a steam or electric road.

WATERVLIET, N. Y.—Forty new arc lamps will soon be added to the municipal street lighting system.

BREVARD, N. C.—The Brevard Light & Power Company is planning to enlarge its plant next spring to meet the increased demands made upon it. The company also plans to install an ice plant next season. J. W. Chapman is manager.

MOORESVILLE, N. C.—Extensive improvements and changes have been made in municipal electric light and power system. The old steam plant has been abandoned and electricity for operating the system is now purchased from the Southern Power Company, of Charlotte. A day service for lighting and motors has just been started. The steam plant is for sale. J. A. Donald is superintendent.

MOUNT AIRY, N. C.—The Mount Airy telephone system, which was owned by E. C. Heinze, has been sold to a new company formed by local business men. The new company is composed of W. G. Sydnor and others.

SCOTLAND NECK, N. C.—The managers of the municipal electric light and power plant are contemplating the installation of a storage battery in the plant. L. R. Mills, Jr., is manager.

WILMINGTON, N. C.—The Consolidated Railways, Light & Power Company is contemplating increasing the capacity of its power plant and will purchase the following equipment: One 500-kw Westinghouse-Parsons turbo-generator set; one 250-hp Babcock & Wilcox boiler, and a 500-hp Alberger barometric condenser.

WINSTON-SALEM, N. C.—The Carolina Valley Railway Company has made application for a franchise to construct and operate its railway system in this city. The company proposes to build an electric railway from High Point to Winston-Salem, and has recently taken over property and holdings of the High Point & Winston-Salem Railway Company. Dee Allen is president of the company.

EDGELEY, N. D.—The Pomona Valley Telephone Company has been granted a franchise to erect a telephone line to Streeter.

FARGO, N. D.—The Fargo & Moorhead Street Railway Company is contemplating an extension to its lines of about one and one-half miles.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has applied to the County Commissioners for a franchise to cross the Hudson Road, a short distance from the Chittenden's Crossing. The railway will be built on a private right of way to complete the general plan of the system in Akron.

CANAL DOVER, OHIO.—The Tuscarawas Valley Transit & Power Company will construct its road from Canal Dover to Canton by the way of Zoar and Bolivar, over a private right of way. The line will be extended from Canton to Columbus passing through Coshocton.

CLEVELAND, OHIO.—President John C. Keys, of the Cuyahoga Light Company, states that if the franchises applied for are granted, four electric light and power plants will be built in the downtown section of the city. The company will depart from the system used in supplying a large amount of electricity, and instead of one large central station will have several smaller plants. One will be located on the river or on the lake front, and will be used for emergency purposes. One station is now being equipped on East Third Street. Another plant in the rear of the Guardian Trust Building has been in operation for some time and is supplying electricity at the low rates proposed in the franchise that is now before the City Council. Mr. Keys states that arrangements will be made to take care of a large amount of business, as the Council has required that the service be extended as rapidly as possible if a franchise is granted.

COLUMBUS, OHIO.—The directors of the Columbus Railway & Light Company have decided to increase the capacity of its plant and place an order for a number of new cars.

MILLERSBURG, OHIO.—At a recent meeting of the stockholders of the Millersburg & Eastern Railway Company the capital stock was increased to $600,000 and the following officers elected: Dr. D. S. Olmstead, president; Daniel M. Miller, vice-president; Joseph Hahn, secretary, and W. W. Adams, treasurer.

NEW BREMEN, OHIO.—A. M. Sternberg, village clerk, writes that the citizens on Nov. 12 voted to issue $20,000 in bonds, the proceeds to be used for an electric light plant.

RAWSON, OHIO.—The Village Council is considering the proposition of lighting the streets of the village by electricity.

SWANTON, OHIO.—Bids will be received until Nov. 25 by the Board of Trustees of Public Affairs for furnishing a deep well pump, together with an electrically driven pump head, motor and the necessary switches and controlling devices; also one elevated tank having an approximate capacity of 22,000 gallons and a tower. A. B. Lathrop is secretary of board.

YOUNGSTOWN, OHIO.—A new 1000-kw generator, driven by a gas engine, will soon be put into operation at the Ohio works of the Carnegie Steel Company. The No. 5 and No. 6 furnaces of the plant will be operated with electric power hereafter.

ZANESVILLE, OHIO.—The Center Valley Railway, Light & Power Company, which has been formed to develop lands and locate manufacturing plants at a point nine miles south of Zanesville, proposes to build a large electric plant to furnish electricity for light, heat and power, and will also construct an electric railway 74 miles in length. Bids will soon be asked for the building and equipment of power plant and railway. H. A. Williams is manager.

MUSTANG, OKLA.—The Mustang Telephone Company has absorbed the Farmers' Mutual Telephone Company, and the following officers have been elected: Frank Dalton, president; F. G. Dennis, vice-president; R. C. Malroy, secretary.

PAWHUSKA, OKLA.—W. H. Cook & Son, of Muskogee, I. T., have been awarded the contract for constructing the water works, electric light plant and sewers, to cost about $100,000.

SHATTUCK, OKLA.—The capital stock of the Shattuck Electric Light Company has been increased from $3,000 to $15,000.

NEW PINECREEK, ORE.—The power house of the California & Oregon Light, Heat & Power Company was recently destroyed by fire. F. E. Russell is chief electrician. It is reported that plans are being considered for rebuilding the plant.

TYGH, ORE.—Arrangements have been made with the Wasco Warehouse Milling Company for furnishing electricity to light the streets and residences of this village. Work will commence immediately on installing the system. John A. McArthur is superintendent of the Wasco Warehouse Milling Company.

PANAMA.—Bids will be received until Dec. 13 at the office of Lieut. Col. H. F. Hodges, corps engineer, U. S. A., purchasing officer, Isthmian Canal Commission, Washington, D. C., for furnishing motor generator sets, switchboard, electric switches and fuse blocks, electric fans, etc., as per circular No. 403.

FRANKLIN, PA.—The Borough Council has granted the Citizens' Light, Heat & Power Company a franchise to light the streets of the town.

JOHNSTOWN, PA.—The Borough Council of East Conemaugh has granted the Southern Cambria Street Railway Company permission to construct and operate an electric railway in this town.

LEBANON, PA.—George C. Unger, of this place, has been awarded the contract to erect a pole line for the transmission of electricity from Mish's Mill to the Weaver bologna factory, a distance of about 15 miles. It is understood that the Swatara Electric Light & Power Company will furnish electricity for lighting the factory.

NORRISTOWN, PA.—We are informed that about $20,000 will be expended for improvements and extensions to the municipal electric light plant. George W. Kit is secretary of the electric light committee.

PHILADELPHIA, PA.—Application for a charter has been made by the Equitable Electric Power Company, which desires to compete with the Philadelphia Electric Company and the United Gas Improvement Com-

pany for furnishing electricity for lighting in this city. The company also hopes to enter the Pittsburg field. It is said that the company will secure power for operating its system from the power plant of the Philadelphia & Western Railroad Company at Cobb's Creek. The incorporators are: James Collins Jones, J. C. Splane, of Pittsburg, and others. It is said that George R. Sheldon, of New York, N. Y., is also interested in the company. Mr. Sheldon was one of the incorporators of the Commonwealth Electric Company, which tried to enter the field here two years ago.

POTTSVILLE, PA.—The new power plant of the Pottsville Union Traction Company has been put into operation and the subsidiary plants at Pottsville and Minersville have been abandoned. The new plant cost $250,000.

WAYNESBORO, PA.—Plans are being considered by the officials of the Chambersburg, Greencastle & Waynesboro Street Railway Company for increasing the output of the power plant to supply electricity for the extension of the line from Greencastle to Chambersburg. J. F. Geiser is superintendent.

CHARLESTON, S. C.—The Sewerage Commissioners have decided to install an electric pump as an experiment to take the place of the compressed air pumps now in use at the sewerage plant with a view of reducing the cost of operation. The Charleston Consolidated Railway, Gas & Electric Company will furnish the energy to operate the pump.

FLORENCE, S. C.—The City Council is reported to be considering the installation of an electric light plant to cost about $25,000.

ABERDEEN, S. D.—The Wagner, Lake Shore & Armour Traction Company, which recently secured a franchise, is planning to organize a new company, which will be known as the Aberdeen Light & Power Company, and will have a capital stock of $200,000. It is said that work is expected to begin on its system here before the first of the year.

BRISTOL, TENN.—It is reported that the Young Men's Christian Association has decided to install an electric plant to light the building by electricity.

BRISTOL, VA.-TENN.—We are informed that the Fish dam development, near Bristol, Tenn., of which Charles Hansel, 43 Exchange Place, New York, N. Y., is engineer, has not yet been financed. The matter of construction has been deferred for the present.

CHATTANOOGA, TENN.—An addition is being built to the power plant of the Street Brothers Machine Works near East End Avenue.

CHATTANOOGA, TENN.—The Chattanooga Electric Company is having estimates prepared for a 1500-kw turbo-generator set, which will increase the output of the plant to 5000 kw.

SOUTH PITTSBURG, TENN.—The municipal electric light and power plant has been purchased by D. A. Tate, of this city, who has been granted an exclusive franchise for ten years and a perpetual franchise thereafter. The conditions are that the city is to be furnished with 50 incandescent lamps of 50 cp for five years free of charge, if at the end of the time the service has been satisfactory the plant will become the property of Mr. Tate without further pay or consideration. The new owner will practically rebuild the plant and replace the wires and other equipment with new.

AUSTIN, TEX.—The Austin Electric Railway Company is increasing the capacity of its power plant by the installation of a 600-hp engine and a 400-kw General Electric generator. W. J. Jones is president of the company.

CHELSEA, VT.—The citizens have voted to instruct the Selectmen to make a contract with the Chelsea Electric Light & Bobbin Company to furnish electricity for street lamps and lighting the town hall from Nov. 1 to April 1, the cost not to exceed $33.33 per month. E. D. Barnes, secretary and treasurer of the company, states that it cannot afford to run the plant at the present rates and has proposed an advance of 50 cents per year on each 16-cp lamp and $33.33 per month for lighting the streets and town hall.

RICHMOND, VA.—The City Council is considering the installation of an electric lighting plant to generate electricity for use at the new pumping station, and may also furnish electricity for lighting the streets and parks.

ANACORTES, WASH.—Application has been made to the City Council for a franchise to operate an electric railway in this city, which, it is intended, shall form part of the projected interurban railway, being promoted by Benjamin Weeks.

CHENEY, WASH.—The large transformers of the Washington Water Power Company at Jamieson were burned out recently, which will put the plant out of commission for some time for repairs. The company furnished electricity for several manufacturing plants in this city which will close down until the plant resumes operation. Electricity for operating the street lighting system of the city is also furnished by the company.

PUYALLUP, WASH.—The City Council has decided to secure the services of an engineer to report fully upon the project of establishing a municipal electric light plant.

SPOKANE, WASH.—C. A. Lunceford, promoter of the Adams County Electric Railway, has organized a company with a capital stock of $10,000,000 to build an electric railway from Spokane to the Columbia River; also a line of boats to be operated in connection with it.

SPOKANE, WASH.—The Interstate Telephone Company is making arrangements to extend its lines to Wallace. It is expected to complete the line as far as Cataldo, which is within 25 miles of Wallace, this fall and complete the work to Wallace early in the spring.

SPOKANE, WASH.—The Washington Power Company has nearly completed its conduit system in this city and will soon place its wires under ground within the fire limits. Electricity for operating the shops of the Great Northern and Northern Pacific shops will, it is understood, be supplied from a small sub-station on East Front Street. The transmission lines on Lincoln Street, which carry power to the towns and mines in the Coeur d'Alene district, will go under ground as far as Third Avenue, the southern fire limit.

WHEELING, W. VA.—The City Council on Nov. 7 made an appropriation of $150,000 for improvements to the gas and electric light plant.

APPLETON, WIS.—Plans have been prepared by W. W. De Long, architect, for a new telephone exchange building for the Fox River Valley Telephone Company to cost $10,000.

EAU CLAIRE, WIS.—The City Council has decided to ask for bids for lighting the streets and highways with either gas or electricity for a term of five years.

MARINETTE, WIS.—The Economy Light & Power Company, of Oconto, has applied to the City Council for a franchise to furnish electricity for lighting and motors in Marinette. The company offers to furnish energy for lighting at 8 cents for the first 20 kw-hours; for 60 kw-hours, 7½ cents; for 100 kw-hours, 7 cents; for 140 kw-hours, 6½ cents; for 180 kw-hours, 5 cents; for 220 kw-hours, 5 cents, and for any over this amount at 4 cents. They also offer to install 90 200-cp arc lamps at $50 per lamp per year for each lamp. If the franchise is granted the company will commence work within 60 days and promises to have the lamps installed before Jan. 1. Power for operating the system will be purchased from the Perley & Company, which has a water power plant of 1000 horse-power in the city of Peshtigo. It is estimated that the cost of the system, including the transmission line from Peshtigo, will be about $13,500.

STANLEY, WIS.—The City Council has granted the Northwestern Lumber Company a franchise to furnish electricity for lighting in this city.

WEST BEND, WIS.—The State Railroad Commission has granted the West Bend Heating & Lighting Company authority to issue $25,000 in capital stock to make improvements to its plant.

CAMPBELLFORD, ONT.—E. C. West, city secretary, writes that John S. Fielding, 15 Toronto Street, Toronto, is engineer for the proposed power plant, which is to be constructed at Middle Falls. The cost of the plant is estimated at $60,000.

COBALT, ONT.—The Town Council is negotiating with the Cleveland Cobalt Company with a view of making a contract for lighting the streets of the town with electricity.

COBALT, ONT.—Franchises have been granted by the municipalities to C. M. Stone, of Cleveland, Frank Latchford and others to construct an electric railway from Cobalt to Haileyburg. The line from Cobalt is to run north to the Silver Queen mine, and will eventually run to New Liskeard.

GALT, ONT.—Estimates for distributing power from Niagara Falls have been submitted by chief engineer of the Hydro-Electric Power Commission. The total cost of a distributing plant for manufacturers was estimated at $46,195; the cost of plant for street lighting at $16,583, and for private service $18,000 to $19,000.

HAMILTON, ONT.—The sub-committee of the Board of Works is negotiating with the Cataract Power Company to install an electric lighting system in the West End. The committee is considering placing Nernst lamps on the streets. W. C. Hawkins is manager of the Cataract Power Company.

LISTOWEL, ONT.—Bids will be received for lighting the town of Listowel with electricity with both arc and incandescent lamps. For further information address C. A. Lee, chairman light committee.

PETROLIA, ONT.—The Petrolia Electric Light, Heat, Power & Gas Company, Ltd., has awarded contracts for gas engines and gas producers, which it is expected will be installed next January. W. G. Fraser is manager.

SAULT STE. MARIE, ONT.—Extensive changes and improvements are being made in the plant of the Togona Water & Light Company. The single-phase, 133-cycle generators are being replaced by 3-phase, 2200-volt, 60-cycle generators. The new dynamos are being installed by the Lake Superior Power Company, from whom the Tagona Light & Power Company purchases its power. The entire station equipment will be owned by the Lake Superior Company, which consists of four 225-kw, alternating current, 2200-volt, 3-phase, 60-cycle generators; one 225-kw motor generator. The 500-volt, direct-current day circuit for motors in the town of Sault Ste. Marie will be abondoned. L. H. Davis is engineer.

ST. THOMAS, ONT.—The City Council has decided to ask the Hydro-Electric Power Commission to furnish estimates of the cost of distributing electricity from Niagara in St. Thomas.

WEST LORNE, ONT.—The West Lorne Electric Light Company, Ltd., is contemplating the installation of a producer gas power plant soon. D. F. Webster is secretary.

WOODSTOCK, ONT.—Chief Engineer Richards, of the Hydro-Electric Power Commission, has submitted to the Council his estimate of the cost of equipment for distributing Niagara power in Woodstock. The total cost is estimated at $18,000.

MONTREAL, QUE.—Bids will be received until Dec. 16 by the fire and light committee of the City Council for furnishing electric energy and gas for lighting the streets, squares and other real estate belonging to the city; also for lighting and heating and industrial purposes for the citizens. Bids are to be submitted separately for gas and electricity.

FORT QU'APPELLE, SASK.—The Provincial Government is making arrangements for the construction of a long-distance telephone line from here to Balcarres, Sask, a distance of approximately 30 miles.

JIMENEZ, MEX.—A. J. Warren and C. D. Norton, formerly with the Parral Electric & Water Company, have acquired the electric light and power plant at Jimenez.

MEXICO CITY, MEX.—Arrangements are being made to operate the Euskaro flour mill by electricity. Two motors having a combined output of 75 horse-power have been installed. The motors were furnished by the Westinghouse Electric Company through its Mexican City agents, C. and O. Braniff & Co.

New Industrial Companies.

THE AMERICAN BATTERY COMPANY, of Cedarhurst, N. Y., has been incorporated with a capital stock of $200,000. The directors are: W. H. Orr, I. T. Kortz, of New York City, and H. F. Rhatigan, of Brooklyn.

THE LECTROID SIGN CLEANING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $500. The directors are as follows: Jacob Cahn, Arthur Cahn and P. Percival Lichtenberg, of New York, N. Y.

THE OLIVER ELECTRIC COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $6,000 for the purpose of conducting a general electrical business, installing and repairing all kinds of electrical machinery. The officers and directors of the company are: S. W. Oliver, president; J. P. Balding, secretary and treasurer, and R. G. Rother.

THE SECURITY ELECTRIC SUPPLY COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $25,000 by M. Jones and others.

New Incorporations.

VENTURA, CAL.—The Ventura Gas & Electric Company has been incorporated with a capital stock of $250,000 by F. B. Cole, R. H. Burnham, D. H. Steele and H. C. Norris, all of Los Angeles.

DENVER, COL.—The Intermountain Railway Company has filed articles of incorporation with a capital stock of $1,000,000. The incorporators are C. H. Chase, T. J. Milner, Caldwell Yeaman, Frank Loveland and Thomas B. Doran, all of Denver. The new company has purchased the Denver & Intermountain Railroad, which operates between Denver, Lakewood and Golden, which will be converted into an electric line.

CHICAGO, ILL.—A charter has been granted to the Woodstock, Marengo & Sycamore Railway Company, of Chicago, with a capital stock of $25,000 for the purpose of constructing a railway from Woodstock to Sycamore. The incorporators are Charles A. Spenny, Edward B. Harang, M. W. Powell, H. S. Hedberg and E. C. Spinney.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago & East Louis Short Line Railway Company for the purpose of building an electric railway from East St. Louis to Chicago. The company is capitalized at $50,000 and the incorporators are: H. C. Osterman, William M. Drennan, H. C. Dolph, Thomas W. Flynn and William Anderson.

EDWARDSVILLE, ILL.—The St. Louis & Staunton Railway Company has been incorporated by George M. Mattis, W. H. Carnahan, C. Zilly, D. E. Brambel and R. H. Watson, all of Champaign, for the purpose of building an interurban railway from Edwardsville to Staunton. The capital stock is $25,000.

MURPHYSBORO, ILL.—Articles of incorporation have been filed with the Secretary of State for the Murphysboro Electric Railway, Light, Heat & Power Company, with a capital stock of $36,000. The company proposes to operate an electric railway and other public utilities. The incorporators are: John G. Hardy, Walter Alexander and Philip H. Eisenmeyer.

PRINCETON, ILL.—The Bureau County Light & Power Company has been incorporated with a capital stock of $50,000 to operate a heat, light and power plant. The incorporators are H. H. Priestly, C. F. Stertevant and B. C. Lindley, of Princeton.

ARDMORE, I. T.—The Ardmore Traction Company has been organized with a capital stock of $500,000 for the purpose of either purchasing the railway system of the present Ardmore Street Railway Company, or procuring a franchise to construct and operate another line.

ST. LOUIS, MO.—Articles of incorporation have been filed for the Carondelet & Webster Groves Railroad Company, with a capital stock of $200,000, for the purpose of building a railway from St. Louis to Webster Groves, a distance of eight miles. Willard E. Winner and J. G. Hughes are the promoters of the project.

RENO, NEV.—Articles of incorporation have been filed for the Lower Truckee Electric Company by T. W. Haines, Oakland, Cal.; W. H. Hall, of Gridley, Cal., and Henry W. Esden, of Reno. The company is planning to build a large dam across the Truckee River near the Logarmarsino's Ranch, a few miles east of Reno, and will also build a large power plant to supply the mines of Fairview, Wonder and Olinghouse with electricity, and will probably extend its lines to Reno and Carson City. Surveys and plans for the construction of the plant have been completed. The company is capitalized at $50,000.

BROOKLYN, N. Y.—The United Consumers' Electric Company has been incorporated with a capital stock of $10,000. The directors are: Laurence O'Byrne and George Fuller.

OKLAHOMA CITY, OKLA.—The Johnstown Electric Company, of Oklahoma City and Johnstown, Pa., has been incorporated with a capital stock of $50,000. The incorporators are: John E. Mognet and Charles M. Moses, of Johnstown, and E. V. Remington, of Oklahoma City.

MT. UNION, PA.—The Mt. Union Light & Power Company has been incorporated to take over the plant and business formerly carried on by Scott Dibert, who is president of the new company. New transmission lines will be built to supply the increasing demand for electricity for lighting and motors. The company has a capital stock of $25,000. Thomas N. Kurtz is treasurer, and John L. Dixon, superintendent.

MITCHELL, S. D.—The Mitchell Illuminating & Power Company has been incorporated with a capital stock of $100,000 by local capitalists. The company will overhaul the electric light plant and will put in a water gas plant to supplant the acetylene plant. Electricity for incandescent lamps will be furnished by the company at 10 cents per kw-hour.

WALLA WALLA, WASH.—Articles of incorporation have been filed for the Washington-Oregon Traction Company. The company proposes to operate in Oregon, Washington and Idaho, and will construct and operate steam and electric railways, and also own and operate steamship lines and control water rights. The company contemplates the construction of about 75 miles of electric railway out of Walla Walla, work on which will begin within a year. Power for operating the system will be secured from the Wenaha River, about 25 miles from Walla Walla. Power will also be furnished for manufacturing purposes.

MARINETTE, WIS.—The Economic Light & Power Company has been incorporated with a capital stock of $25,000 by Albert Gillette and others.

Legal.

PATENT FOR ALLOY FOR BEARINGS HELD VALID.—It has been held that the Hendrickson and Clamer patent No. 654,402, for an alloy for anti-friction bearings, which consists of a copper tin-lead alloy, having "less than 7 per cent of tin and more than 20 per cent of lead and the balance of copper," covers a superior alloy for journal bearings, having a higher percentage of lead, which is the lubricant, than it was previously thought possible to make successfully. It discloses invention, and is not void for anticipation nor lack of novelty, nor because of prior knowledge and use of the invention. The mere substitution of one material for another is not, as a rule, patentable. But to this there are exceptions. And while it may not be possible to define just when it is so, it must be recognized that, under some circumstances, the adaption of certain materials, singly or in combination, to the production of certain desired results, may amount to invention; and that too, even though it involves no more than the taking advantage of certain inherent qualities, developed or discovered experimentally. This is particularly the case with regard to composite mixtures or alloys of metal, such as is the character of the device in suit, the object of which, as declared by the inventors, was to provide an anti-friction alloy for journal bearings, which should hold up within itself more lead than was theretofore considered possible. The value of alloys, composed of tin, lead and copper, for the bearings of railroad cars and engines, had long been recognized, but up to 1892 there had been no attempt at any definite mixture; old brass and copper scrap and shells, of heterogeneous character, being somewhat indiscriminately made use of. About that time, however, the invention in suit began to take definite form. Ajax Metal Company vs. Brady Brass Company, United States Circuit Court, 155 Fed. Rep. 407.

OPERATION OF ELECTRIC LIGHT PLANT BY CITY AND CONSEQUENT LIABILITY FOR NEGLIGENCE.—Under the statutes of the state of Nebraska a city of the second class of less than 5000 inhabitants is authorized to operate an electric lighting plant for municipal and commercial purposes. In an action against the city of Crete, which maintained and operated a lighting system by virtue of the statutory power, the plaintiff was a railway brakeman in the employ of the Chicago, Burlington & Quincy Railway Company, which operates a line of railway through the limits of the defendant city. His cause of action was based upon the complaint that the defendant, in the operation of its lighting plant, had stretched wires over and across the right of way of the railway company in so negligent and careless a manner that they were not sufficiently high to clear the body of a man standing on top of a freight car in the usual course of the operation of the trains of the railway company; and that the plaintiff, while engaged in his duties as a brakeman, without knowing the dangerous situation of the wires, and in the darkness of the night, was caught by one of the wires of the defendant's lighting system, thrown to the ground and seriously injured. It was urged that the city could not be held liable because at the time the accident occurred the wires were not in use, their commercial use having been abandoned; it was conceded that, had the accident occurred while the wires were in actual use, the defendant would have been liable for the negligent acts and omissions of its servants. It was held that, under the facts and circumstances presented, the city was liable, as it was expressly authorized by statute to erect and maintain electric lighting plants,

and a municipality that lawfully engages in commercial enterprises is liable to the public the same as an individual. Todd vs. City of Crete, Supreme Court of Nebraska, 113 N. W. Rep. 172.

ACTS OF AN EMPLOYEE CONSTITUTING CONTRIBUTORY NEGLIGENCE PRECLUDING A RECOVERY OF DAMAGES FOR INJURIES CAUSED BY ELECTRIC SHOCK.—An action was brought against an electric street railway company for damages for the death of an employee, who was engaged as a "pitman," and whose duty it was to remove the "plows" from the cars as they passed from a line, using the underground system for the transmission of energy, to the tracks of the defendant on which the overhead trolley system was used. It appeared that the employee's death resulted from his unnecessarily touching the uninsulated parts in adjusting the leads connecting the motive power of one of the cars with the overhead circuit. It was held by the United States Supreme Court, in the case of Looney vs. Metropolitan Railroad Company, 201 U. S. 480, that the employee was guilty of contributory negligence, and that the company was, therefore, relieved from liability for damages, although the conductor of the car was negligent in permitting the trolley pole to come in contact with the trolley wire while the employee was in the act of removing the plow. The decision in effect holds an employee to the same standard of care and caution in handling an electric wire, which he has a right to assume is "dead," that he is bound to exercise in handling a "live wire." Where the employee is found to have been contributorily negligent, the company by which he was employed or which owned the apparatus which caused the accident cannot be held in damages. What acts on the part of an employee amount to contributory negligence is a question which has been presented in many cases, and it is held that the question is one for the jury to determine. In Harrown vs. Brush Electric Light Company, 46 N. E. Rep. 291, it was held by the New York Appellate Division that the jury could properly find that the failure of a lamp trimmer to use rubber gloves in trimming an arc lamp in the day time on a supposed dead wire was not negligence which contributed to his death from a shock due to a crossed wire where it was only customary to wear such gloves, when trimming a lamp at night on live wires, and where it would have been impossible for him to do the amount of work required of him had he used rubber gloves. In General Electric Company vs. Murray, 74 S. W. Rep. 50, the finding of a jury that an experienced electric lineman, injured by coming in contact with two high-voltage wires improperly placed within a few inches of each other, on the same side of the pole, was sustained by evidence that he had no knowledge that they were live wires, although he knew that the current would be turned on as soon as the repairs then in progress were completed, and testified that he might have escaped injury had he known the current was on, and that it was good practice to handle all wires as though they were live wires, unless they were positively known not to be charged, and that such was the general custom among linemen. Where the danger is obvious, neglect to take ordinary precautions against electric shock will defeat a recovery. Thus, where a lineman was sent to look for a break in the circuit while the current was on, and took with him a defective shunt cord, which he himself selected from among others which were good, and after finding the break, grasped the shunt cord at its defective end, and at the same time, with his other hand, grasped the naked end of the line wire, and thereby received a deadly current, which he would not have received by taking hold of the shunt cord if he had not taken hold of the line wire at the extreme end where it was not insulated, it was held that there could be no recovery of damages against the company. Piedmont Electric Illuminating Company vs. Patteson, 6 S. E. Rep. 4. And neglect to use rubber gloves provided for the very work of handling wires when a lineman is making connection of wires on a high pole, and is killed by touching their exposed ends, was held in Junior vs. Missouri Electric Light & Power Company, 29 S. W. Rep. 988, to constitute contributory negligence. A lineman cannot recover of an electric light company for injuries received from electric wires occurring by reason of a defect in his gloves, which it was his own business to inspect and keep in good condition, and to exchange, when necessary, for new ones, although the gloves were thrown to him from a wagon, with directions to put them on, by a foreman, the latter having no special charge of the gloves and his direction being merely advisory. Smart vs. Louisiana Electric Light Company, 17 So. Rep. 346. A lineman, employed by a telephone company, who receives a shock from a charged guy or span wire belonging to a street railway company is chargeable with negligence which will preclude his recovery of damages from the telephone company, where he failed to test the insulation, although he had apparatus for the purpose and knew that defects in the insulation of such wires were common, and that there were no persons but the linemen to make such tests. Anderson vs. Inland Telephone & Telegraph Company, 53 Pac. Rep. 657. In Law vs. Central District Company, 140 Fed. Rep. 558, it was held that a cable splicer, working for a telephone company, who, on climbing a telephone pole to repair the sheathing of a cable, took hold of a guy wire without noticing that it was in contact with an electric light wire at a point not a foot away from his eyes, was chargeable with contributory negligence such as would defeat his right to recover damages from the telephone company for injuries, occasioned by the resulting shock, although his vision was hampered by the fact that the sun was in his eyes. 50 Sawyer's Edition 564.

Obituary.

MR. D. L. BENSON, for a number of years past on the construction and operating staff of H. M. Byllesby & Company, of Chicago, Ill., died at the Lake Geneva Sanitarium, Lake Geneva, Wis., after a lingering illness, Monday, Nov. 4, at the age of forty years. Mr. Benson was well known in the electric light, street railway and gas fields of the Middle West, having been prominently connected with the construction of utility plants at Shelby, Ohio; Muskogee, I. T.; Oklahoma City, Okla.; Ottumwa, Ia., and other points. He was a man of marked executive ability and stood deservedly high in his chosen field. He is survived by a widow and a daughter.

WILLIAM F. SHIEBLER.—Mr. William F. Shiebler, a Maiden Lane jeweler in New York, died at his home in Brooklyn on Nov. 13. Mr. Shiebler was formerly a telegraph operator in Washington. He received at Washington the first message which came over the first Atlantic cable laid between this country and Europe, and delivered it in person to President Buchanan at the White House, to whom it was addressed. He served as an operator in and about Washington all through the war. In 1870 he retired from the telegraph business to enter the firm of George W. Shiebler & Co., jewelers and silversmiths. He was a member of the Old Time Telegraphers' and Historical Association, and was one of the four or five surviving operators in the country who worked the old House instruments. Mr. Shiebler was 66 years of age, and is survived by his widow and four children.

Personal.

MR. A. BICKEL has resigned as sales manager of the Hodge Electric & Manufacturing Company and is now identified as contract manager with the Freeborn Engineering & Construction Company, Scarritt Building, Kansas City, Mo.

MR. H. W. PECK has resigned as assistant superintendent of the Consolidated Gas & Electric Company, and has accepted a position with the Rochester Railway & Light Company, of Rochester, N. Y., as assistant electrical engineer.

MR. F. R. WELLES, of Aboilard & Company, French representatives of the Western Electric Company, is again visiting his native country, and is at present in Chicago. He will spend a little time in New York before returning to Paris, where he has made his home for many years past.

MR. S. MATSUMO, mechanical engineer of the Imperial Government Railway of Japan, has arrived to pay a visit to the Westinghouse works at East Pittsburg, with a special view to inspecting the single-phase, alternating-current railway system. He will also take a trip over the Pittsburg & Butler Electric Railway to see this system in practical operation, and will inspect some of the other large local industrial plants.

MR. S. MITSUI, an engineer of Osaka, Japan, is making a visit of a few weeks in this country to inspect electric railway and lighting plants and electrical apparatus ordered here by electric lighting and railway companies in Japan. He was in New York last week and from this country goes to Switzerland, where he will spend several months studying hydraulic installations.

MR. WILLIAM S. GORSUCH, of the electrical engineering department of the New York Central & Hudson River Railroad Company, has been selected by the authorities of the Y. M. C. A., of New York, to conduct its evening course in electricity. This course extends over two years. The first is devoted to the principles of electrical engineering and the second to their practical application. The local power plant, together with the well-equipped laboratory, will be used for demonstration.

RENNSELAER POLYTECHNIC INSTITUTE.—The New York Alumni Association of the institute had its annual dinner at the Hotel Astor on Nov. 8 when there was a large attendance and much enthusiasm. President E. S. Jarrett was in the chair and among the party were fifty seniors from Troy. The guests and speakers included Prof. Burr, of Columbia; Mr. Charles Macdonald, Mr. N. P. Lewis, engineer of the Board of Estimate and Apportionment; Mr. O. F. Nichols, chief engineer of the Bridge Department, and Mr. J. M. Wakeman, vice-president of the McGraw Publishing Company.

MR. A. L. WHIPPLE, eastern manager of the Curtain Supply Company, of Chicago, has resigned that position to become second vice-president of the Telharmonic Securities Company, of New York. This company is the financial agent of the Cahill Telharmonic Company, of Broadway and Thirty-ninth Street, New York, which is developing the distribution of telharmonic music by electricity. Mr. Whipple is one of the best known railway supply men in the country through the active part taken by him on the entertainment committees at the last street railway convention and at previous conventions of the Master Car Builders and Master Mechanics. He has been connected with the Curtain Supply Company for the last nine years and has been engaged in the railway supply field for fourteen years. During the last convention of the Master Car Builders and Master Mechanics at Atlantic City Mr. Whipple made an effort to have telharmonic music transmitted by wire from New York to Atlantic City for the entertainment of those in attendance at the convention. It was largely through the negotiations carried on in connection with this proposal that Mr. Whipple became intimately acquainted with the system of the Telharmonic Company, a fact which led up to the present engagement.

DR. A. G. BELL.—After many years of experimental work the machine with which Alexander Graham Bell hopes to solve the problem of aerial navigation was successfully launched at Baddeck, Nova Scotia, on Nov. 10, in the presence of a large number of intimate friends of the inventor.

The launching took place at Prof. Bell's laboratory. Mrs. Bell, in breaking a bottle of champagne over the bow the ship, declared its name to be Signet. The great doors of the workshop were thrown open, and the kite was conveyed to a float upon which it was lowered out on the waters of Bras d'Or Lake. Owing to adverse weather conditions, however, a flight was not attempted. The ship, or kite, in itself a section of a tetrahedron, is 13 meters long on top, 10 meters along the bottom, by 3 meters deep. It is composed of 3393 units, or small tetrahedrons, two faces of which are covered with silk, this forming a two-winged cell. These cells are arranged to give, as the result of many tests, the maximum stability with the lightest weight. A hole has been cut through the center of the contrivance to furnish accommodation for the motor and a navigator. The ship is also provided with a bow for flying purposes. Three floats are used as a part of its construction to support it while on the lake. A motor with four cylinders of 20 horse-power will drive two solid screw propellers on the same shaft, but in opposite directions. With the motor in position the airship weighs 220 pounds. Prof. Bell says he does not claim for the Signet that he has now solved the problem for which it was constructed. He says the threshold has been merely reached in the development of the machine, and the experiments now to be made will be mainly productive in furnishing data for future experiments.

Trade Publications.

CALIBRATOR FOR WATT-HOUR METERS.—Bulletin No. 1097, of the Fort Wayne Electric Works, Fort Wayne, Ind., deals with a convenient portable rotating standard meter for calibrating watt-hour meters in service.

TELEPHONE MANUFACTURE.—The Dean Electric Company, Elyria, Ohio, has issued a booklet describing its telephone factory. For the third time within the three years of its existence, the company has been compelled to make additions to its plant.

SPRAGUE GENERATORS.—Bulletin 107 of the Sprague Electric Company has for its subject continuous-current direct-driven generators for general service. This type of generator is described and illustrated in full detail and views of a number of plants are given in which it has been installed.

Business Notes.

THE ALUMINUM COMPANY OF AMERICA, formerly the Pittsburg Reduction Company, has established an office at 1331 Candler Building, Atlanta, Ga., under the management of Mr. John H. Finney, formerly of its St. Louis office.

HORNSTEIN & CORY.—Mr. F. C. Hornstein and A. S. Cory have formed a copartnership in Indianapolis, Ind., with headquarters in the Pythian Building. The firm is conducting a business in steam and electrical appliances, and carries a complete line of goods. Mr. Hornstein was formerly connected with the Warner Arc Lamp Company, Muncie, Ind.

THE WESTERN ELECTRIC COMPANY, Chicago, during the past year at its Clinton Street plant produced telephone switchboards to give service to 1,000,000 subscribers, while telephone sets were turned out at the rate of 100,000 per month, and wire was insulated at the rate of 6,500 miles per day. This company has 26,800 employees, 8750 of which are at the Clinton Street plant. The sales for the company's fiscal year, 1906, amounted to $69,000,000.

THE ALLIS-CHALMERS COMPANY has won a substantial bonus for delivering to the American Gas & Electric Company, Scranton, Pa., a 1500-kw steam turbo-generator fully a month in advance of the date specified. The equipment for the plant comprises two of these units, which are designed to receive steam at 150 lbs. per square inch and deliver three-phase, 60-cycle energy at 4000 volts. In addition to the Scranton turbine, Allis-Chalmers machines have been installed in the Canton, Ohio, and Madison, Wis., plants of the American Gas & Electric Company, one of which, that at Canton, has been operating continuously for several months.

PITTSBURG GAGE & SUPPLY COMPANY.—When John Wanamaker built his new store in New York City the Pittsburg Gage & Supply Company, Pittsburg, Pa., equipped his power plant with a White Star continuous oiling system. This installation having proved its usefulness, Mr. Wanamaker has just ordered a duplicate system for his Philadelphia store. The Pittsburg Gage & Supply Company is also furnishing the Lackawanna Steel Company's Lackawanna, Pa., plant with its third system. The company has just moved into its new seven-story factory, where, with unlimited facilities, it will be better able than ever to fill orders promptly. It might be said that its new plant is the largest and most complete of its kind between New York and St. Louis.

THE EXCELLENT EXCELLO.—We are advised by the Excello Arc Lamp Company, 24 East Twenty-first Street, New York, that the large contracts placed lately by the United States Department of the Interior on behalf of the Ellis Island Immigration Service include, among others, a considerable number of Excello luminous arc lamps. These contracts are part of appropriations involving a total expenditure of more than half a million dollars, necessitated by the improvements the Department is making. The Excello lamps which have been decided upon, after exhaustive trials with other illuminants, are used for both outdoor and indoor service and are the Excello Snow Ball type, a recognized type of lamp producing the pure white light of high candle power. To judge from the repeated orders which the Excello Company has received since its first arcs were installed at Ellis Island the lamps give great satisfaction to the Department.

THE WISCONSIN ENGINE COMPANY, Corliss, Wis., which has built some very large and successful Corliss steam engines, is building gas engines for all services in sizes from 400 b. h. p. to 5000 b. h. p. The engines utilize natural gas, producer gas, coke-oven gas or blast-furnace gas in the Otto cycle (4-stroke), and are of the horizontal tandem and twin-tandem double-acting type. This company controls the Sargent patents on internal combustion engines and has employed Mr. Charles E. Sargent as the engineer of its gas engine department. The gas engines built by the Wisconsin Engine Company bear some of the distinctive features of their big Corliss engines. There is but one poppet valve for each explosion chamber, and this is located on the bottom of the cylinder. Provision is made for preventing the dangerous pressures caused by possible pre-ignitions, and the engines are started automatically. Tests of even small Sargent engines show a heat consumption of less than 9000 B. T. U. per brake hp-hour. This company has recently shipped some large steam engines to the Illinois Steel Company, Jones & Laughlin Steel Company, Packard Motor Car Company, American Sheet & Tin Plate Company, Amoskeag Manufacturing Company, New Hampshire Spinning Mills, National Tube Company, City of Milwaukee, Carnegie Steel Company, American Woolen Company, United States Envelope Company and the Carnegie Natural Gas Company.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED NOV. 12, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

870,539. SHAFT OSCILLATOR; W. F. Bouché, Norwood, Ohio. App. filed Sept. 14, 1905. A form of shaft oscillator, having a stationary disc opposite a spring buffer revoluble with the shaft and transmitting endwise movement thereto through a steel ball guided by a radial arm.

870,545. PLATING DEVICE; Geo. W. Clough, Cleveland, Ohio. App. filed Oct. 10, 1906. A rocking receptacle for holding metal articles while they are immersed in a plating liquid heavily charged with metal in solution, and through which the electric current is passed to decompose it and liberate the included metal and deposit it upon the articles.

870,551. CENTRAL ENERGY TELEPHONE SYSTEM; Francis W. Dunbar, Chicago, Ill. App. filed Dec. 19, 1900. The combination with a telephone line of a charging source of electricity bridged between the limbs thereof, a pair of electromagnetic windings included in said bridge, one on each side of said source of electricity, and a signaling device rendered inert by the passage of a current through both of said windings and adapted to be actuated by the passage of current through one of said windings, substantially as described.

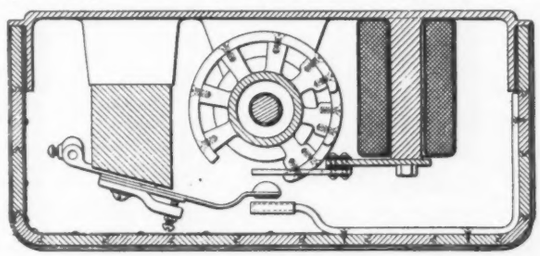
870,555. CONTROLLER; F. W. Garrett, Norwood, Ohio. App. filed Aug. 21, 1905. A blow-out magnet has a plurality of polar extensions of like polarity located between the segments of the controller and adjacent to the contact fingers.

870,564. THIRD-RAIL ELECTRIC RAILWAY SYSTEM; C. Kozesnik, New York, N. Y. App. filed June 16, 1904. The third-rail is made in sections normally de-energized, but which are electrically connected in circuit during the passage of a train by the magnetic attraction of a magnet on the train.

870,574. FIRE-ALARM SYSTEM; C. W. McDaniel, Kansas City, Mo. App. filed April 23, 1906. Diagram of circuit for a telephone system of the usual character, and including means whereby a fire-alarm signal is automatically sent by a magnetically acting automatic switch.

870,577. ELECTRICAL WATER HEATER; E. Naumer, New York, N. Y. App. filed July 17, 1906. The water is passed through a resistance element comprising serially connected hollow carbon rods.

870,595. CONTROLLER; L. L. Tatum, Norwood, Ohio. App. filed April 16, 1906. The controller contacts have a toggle lever connection



870,555.—Controller.

by which they are moved for the purpose of attaining a wide separation to open the circuit and a very strong engagement to close the circuit.

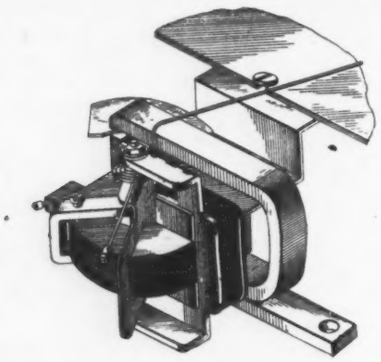
870,596. MOTOR CONTROLLER; L. L. Tatum, Norwood, Ohio. App. filed Aug. 31, 1906. Relates to modifications of the above.

870,611. SERIES SHUNT FOR DYNAMO ELECTRIC MACHINES; H. C. Beekley, Norwood, Ohio. App. filed Nov. 29, 1905. Includes a frame having separable sections capable of being assembled in different sizes and each of which has insulting studs by which the resistance element is supported. In this way a resistance element of any desired size can be constructed.

870,621. ELECTRIC RAILWAY SIGNALING SYSTEM; N. P. Fraser, et al., Carsonville, Mich. App. filed May 17, 1907. Relates to signaling system whereby trains may receive warning when they approach within a danger limit. Makes use of special sectional third-rail.

870,622. ELECTRIC SIGNALING SYSTEM; W. H. Gilman, Medford, Mass. App. filed Oct. 31, 1906. A railroad signal system of the type in which communication is had to various points along the roadway over a single wire. A particular station of the line is responsive by mechanism acting with current pulsations of a certain character.

870,632. ELECTRICAL MEASURING INSTRUMENT; J. M. Lea, Chicago, Ill. App. filed June 4, 1906. Relates to electrical measuring instruments for alternating currents having a primary coil and



870,632.—Electrical Measuring Instrument.

a secondary coil linked in inductive relation to the primary by a suitable laminated core. The secondary coil is movable and carries an indicator.

870,634. CALLING DEVICE FOR TELEPHONE EXCHANGES; Frank A. Lundquist, Chicago, Ill. App. filed May 28, 1906. In a calling device, the combination with a plate, and a lever adapted to move in one direction on one side of said plate and in the opposite direction on the other side, of an electrical connection arranged to be closed when the lever is on one side of the plate and to be open when it is on the other side.

870,643. AMALGAMATOR; G. E. Paullins, Colorado Springs, Col. App. filed Oct. 6, 1905. A metallic trough has a longitudinal rotatable shaft therein, rigid arms from which carry inclined blades movable in close proximity to the walls of the trough. Electrodes are provided by which the amalgam is subjected to a current.

870,674. APPARATUS FOR ELECTROCHEMICAL ANALYSIS; G. A. Guess, et al., Silverton, Col. App. filed April 26, 1905. An electrochemical apparatus comprising a combination of three terminals slit longitudinally, and an independent electrode arranged in the slit of each terminal and frictionally held thereby, the electrode in the metal terminal adapted to receive the deposit, and the several terminals connected up in the circuit.

870,675. ELECTRODE; G. A. Guess, et al., Silverton, Col. App. filed April 26, 1905. Relates to details of an electrode for the above.

870,688. AUTOMATIC ELECTRIC STORING DEVICE; J. W. Ringer, Castleton, Ind. App. filed July 17, 1906. An arm moves over a circular series of contacts so as to cut out the end cells of a series. The position of the arm is governor controlled.

870,714. ELECTROTHERMAL PROTECTOR; F. B. Cook, Chicago, Ill. App. filed Feb. 15, 1907. Two conical shells telescoped together, in which relation they are maintained by solder. The interior shell contains a thermal element which melts the solder and allows the shells to separate.

870,732. BURGLAR-ALARM; H. R. Lassen, Hamburg, Germany. App. filed May 21, 1907. Patentee has a pair of arcuate spring blades disposed in the path of a weight which electrically connects them to close an alarm circuit.

870,736. ELECTRIC FIXTURE; H. R. Mitchell, North Yakima, Wash. App. filed Feb. 23, 1907. A canopy fixture of the type having a transverse spring reel from which the electric connections depend and which is operated in a manner analagous to a curtain roller.

870,755. TROLLEY POLE GUIDE; L. A. Allen, Passaic, N. J. App. filed Aug. 14, 1907. Patentee has a long roller of double conical form which is impelled into position to guide the trolley wheel on the wire by tension on the operating core.

870,779. ELECTRIC SOLDERING IRON; W. G. Hartwig, Chicago, Ill. App. filed March 21, 1907. The head of the soldering iron is made hollow and contains carborundum crystal which is in the electric circuit so as to be heated by the passage of the current.

870,803. ELECTRICAL MEASURING INSTRUMENT; C. B. Thwing, Philadelphia, Pa. App. filed Jan. 25, 1907. Has a terminal magnet with an armature movable in its field and a thermal element for separating the magnet poles to compensate for changes in temperature.

870,816. VEHICLE MOTOR CONTROL SYSTEM; W. Cooper, Wilkinsburg, Pa. App. filed Jan. 3, 1906. Has means for decreasing the torque exerted upon the leading pair of wheels of each truck during starting.

870,847. METHOD OF MAKING A JOINT IN THIN FLAT MATERIAL; A. F. Rietzel, Lynn, Mass. App. filed Oct. 15, 1903. The process of forming a joint in thin metal which consists in pressing the up-turned margins or borders of the material into contact with one another by the pressure applied to clamping or holding devices, so as to cause them to be in contact throughout substantially the whole plane surface of said up-turned portion and applying a lateral pressing force while they are in heated condition.

870,891. AUTOMATIC GAS CONTROLLER; Joseph C. Landes, Collegeville, Pa. App. filed Feb. 15, 1907. Gas controller of the type in which the gas is made to flow for a certain interval by the deposit of a coin. Has means for automatically opening the circuit of a cut-off device when the gas in a certain receptacle is exhausted.

870,892. ALTERNATING CURRENT MOTOR; Robert Lundell, New York, N. Y. App. filed Sept. 26, 1905. Alternating current motors having a commutator and operated by a single or uniphase current. Has means for reversing the direction of rotation of the armature or rotary part. Employs stationary brushes in combination with a pole changing controller.

870,893. ALTERNATING CURRENT MOTOR; Robert Lundell, New York, N. Y. App. filed Nov. 27, 1905. Relates to modifications of the above.

870,915. PROCESS OF MANUFACTURING ARSENIC COMPOUNDS OF LEAD; Cornelius D. Vreeland, Montclair, N. J. App. filed Feb. 5, 1906. The process of manufacturing arsenic compounds of lead which consists of the formation of a soluble salt of lead by electrolysis in the presence of a soluble compound of arsenic and the simultaneous precipitation of the lead.

870,927. ELECTROTHERAPEUTIC INSTRUMENT; Benjamin Y. Boyd, Chicago, Ill. App. filed Jan. 18, 1907. A therapeutic apparatus for throat diseases and including specially constructed electrodes suited to the anatomy of the throat.

870,938. ALTERNATING CURRENT GENERATOR; George H. Cove, Roxbury, Mass. App. filed May 7, 1906. A series of fixed magnets having their poles set alternately of opposite polarity and co-operating with electromagnets which oscillate back and forth, thereby generating alternating currents in their circuits.

870,946. CONTROLLING MECHANISM FOR ELECTRIC CIRCUITS; Taylor T. Fogel, Reading, Pa. App. filed May 1, 1907. Relates to controlling mechanism for electric circuits and particularly rheostats or starting boxes. Designed to operate for underload and overload conditions.

870,950. TROLLEY; Walter P. Gisske, Los Angeles, Cal. App. filed April 10, 1907. Flaring arms are fulcrumed on the axis of the trolley wheel so as to swing upward and guide the wheel on the wire by springs which act when the vertical pressure of the wheel against the wire is released.

870,963. ALARM BOX ATTACHMENT; Lee G. Holden, Portland, Ore. App. filed March 12, 1906. Provides means for throwing open the door when unlatched and while the local alarm is sounding, which will call the operator's attention to the hook or handle necessary to operate the distant or central alarm or signal.

870,970. ALTERNATING CURRENT METER; Robert C. Lanphier, Springfield, Ill. App. filed Sept. 8, 1904. Provides a mercury motor watt-hour meter for measuring alternating currents which is free from the field displacement ordinarily encountered in meters of this type.

870,973. STORAGE BATTERY; Homer E. R. Little, New York, N. Y. App. filed Jan. 17, 1907. Relates to specific details of the electrolyte and the composition of electrodes used.

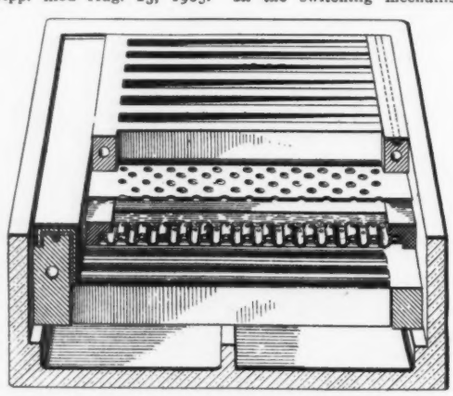
870,985. CARBON ELECTRODE FOR GALVANIC ELEMENTS; Wilhelm Mollenbruck and Wilhelm Dielmann, Dusseldorf, Germany. App. filed Oct. 23, 1906. A carbon electrode for dry batteries composed of circularly grouped carbon members firmly embedded into the ordinary depolarizing matter, and forming a central cavity and a removable carbon contact plug adapted to fit into said cavity and come in close contact with said carbon members.

870,999. TROLLEY HARP; Samuel T. Simmons, Columbus, Ohio. App. filed April 16, 1906. The trolley wheel swings on an axis in vertical alignment with that of its pivot support through a limited angle.

871,002. INSULATING FIXTURE; Louis Steinberger, New York, N. Y. App. filed Nov. 5, 1906. Has a ring with eyebolts extending radially therein and sleeves of insulating material extending through the eyebolts, said sleeves having metallic members by which they are fastened to the ring.

871,042. TELEPHONE EXCHANGE; Samuel A. Norstrom, Chicago, Ill. App. filed July 13, 1905. The combination with a polarized magnet, a battery, and means by which impulses in a given direction are sent from said battery through said magnet of a second magnet, and means by which upon completing an impulse through the first magnet, said second magnet will cause a brief impulse of the kind described to flow in the opposite direction through the first-mentioned magnet.

871,043. TELEPHONE EXCHANGE; Samuel A. Norstrom, Chicago, Ill. App. filed Aug. 23, 1905. In the switching mechanism of a



870,973.—Storage Battery.

telephone exchange, the combination with a movable ratchet wheel, of a pawl-locking device carried by said wheel and adjustable with respect thereto.

871,067. APPARATUS FOR ALIGNING CONDUIT SECTIONS; Joseph T. Rice, West Hoboken, N. J. App. filed March 11, 1907. Relates to devices for aligning conduit sections when laying the latter under ground to contain electric wires or serve as ducts generally. Has strips in opposed relation and having inclined meeting rideways which co-act in the movement of said strips in opposite directions and at right angles to the plane of the hypotenuse or meeting surfaces of the strips.

871,092. SELECTING DEVICE FOR TELEPHONE EXCHANGES; Frank A. Lundquist, Chicago, Ill. App. filed Jan. 16, 1905. A numbered dial, a pointer adapted to be moved to any position on said dial, automatic devices for returning said pointer to a normal position, means controlled by the movement of said pointer for sending a series of electrical impulses over a given course, a switch, and means for operating said switch by the movement of said pointer, so as to send an additional electrical impulse over a second course.